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TECHNICAL MANUAL
for
OSCILLOSCOPE
AN/USM-105A

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
CLEVELAND 8, OHIO

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS

Contract: NObsr 85316 *Approved by BuShips: 31 October 1961*

CHANGE 1 to NAVSHIPS 93658(A)

0967-085-3012
Formerly 0280-618-5005

30 July 1964

INSTRUCTION SHEET

CHANGE 1 to Technical Manual for Oscilloscope AN/USM-105A
NAVSHIPS 93658(A)

This permanent change revises the book to include supplementary and corrective information affecting the Maintenance Parts List, Section 7.

Maintenance Support Activities and holders of equipment accompanied by Technical Manuals shall insert this CHANGE in the technical manual immediately upon receipt.

1. Remove superseded pages and insert revised or supplementary pages as indicated below:

Page	Remove	Insert
TP/ii	Orig. /Orig.	Ch. 1/Ch. 1
---	---	SUPPLEMENTARY PARTS LIST, TABLE 7-1A (Pages 7A-1 through 7A-3) in front of the original PARTS LIST, TABLE 7-1.

2. Destroy superseded title pages but not before manual has been checked against the "List of Effective Pages" (Page ii CHANGE 1).

3. Insert this Instruction Sheet immediately behind the front cover of the manual.

NAVSHIPS 93658(A)

TECHNICAL MANUAL

for

OSCILLOSCOPE
AN/USM-105A

DEPARTMENT OF THE NAVY
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List of Effective Pages

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
TITLE PAGE	CHANGE 1	4-0 to 4-6	ORIGINAL
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2-1	ORIGINAL	7-1 to 7-49	ORIGINAL
3-0 to 3-9	ORIGINAL		

SECTION 7A

SUPPLEMENTARY PARTS LIST

NOTE

"This parts list has been corrected by means of the following supplementary table. For any given item, always refer first to the appropriate supplementary table, since it completely supersedes any corresponding listing in the basic table. If no information is shown for a given item, refer to the basic table for the required information."

TABLE 7-1A SUPPLEMENTARY PARTS LIST

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C105		CAPACITOR, FIXED, MICA, 240 uf, 5% 500v, type CM15D241JN3 per MIL-C-5B	Bypass capacitor for V101 cathode, Figure 5-16
C107		CAPACITOR, FIXED, MICA, 33 uuf, 5%, 500V, type CM15C330JN3 per MIL-C-5B	Coupling capacitor for V104A, Figure 5-16
C108		CAPACITOR, FIXED, MICA, 75 uuf, 5%, 500V, type CM15C750JN3 per MIL-C-5B	Clamp capacitor for V103 cathode, Figure 5-16
C109		CAPACITOR, FIXED, MICA, 47 uuf, 5%, 500V, type CM15C470JN3 per MIL-C-5B	Coupling capacitor for V104B, Figure 5-16
C114		CAPACITOR, FIXED, MICA, 100 uuf, 5%, 500V, type CM15C101JN3 per MIL-C-5B	Coupling capacitor for V105A, Figure 5-16
C119		CAPACITOR, FIXED, MICA, 220 uuf, 5%, 500V, type CM15D221JN3 per MIL-C-5B	Decoupling capacitor for V105B grid, Figure 5-16
C124		CAPACITOR, FIXED, MICA, 68 uuf, 5%, 500V, (76433 #MCM15D680J)	Bypass capacitor for V109 plate, Figure 5-16
C132		CAPACITOR, FIXED, MICA, 390 uuf, 5%, 500V type CM15D391JN3 per MIL-C-5B	Bypass capacitor for arming input, Figure 5-16
C134		CAPACITOR, FIXED, MICA, 10 uuf, 5%, 500V type CM15B100KN3	Coupling capacitor for V114 grid, Figure 5-16
C302		CAPACITOR, FIXED, PAPER, molded plastic case, .0015 uf, 10%, 6000v, (09023 # PKM-60D15)	Bypass capacitor for V301A, Figure 5-24
C304		CAPACITOR, FIXED, MICA, 470 uuf, 5%, 500v type CM15D471JN3 per MIL-C-5B	Coupling capacitor for V302 grid, Figure 5-23
C306		CAPACITOR, FIXED, PAPER, molded plastic case, .0047 uf, 20%, 6000v, (09023 # PKM-60D47)	Filter capacitor for V303, Figure 6-6
C312		CAPACITOR, FIXED, MICA, 22 uuf, 5%, 500v type CM15C220JN3 per MIL-C-5B	Coupling capacitor for blanking to V305, Figure 5- 4
C316		CAPACITOR, FIXED, MICA, 27 uuf, 5%, 500v type CM15C270JN3 per MIL-C-5B	Coupling capacitor for V306B, Figure 5-23
C403		CAPACITOR, FIXED, ELECTROLYTIC, 45 uf, 450v, -40°c to + 85°c, type CE41 C45OR per MIL-C-62A	Bypass capacitor for CR401, CR402, CR403, CR404, Figure 5-25
C1009		CAPACITOR, FIXED, MICA, 1000 uuf, 2%, 500v, type CM20D102GN3 per MIL-C-5B	Timing capacitor for sweep time on S1001, Figure 5-27

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1011		CAPACITOR, FIXED, MICA, 82 uuf, 5%, 500v type CM15C820JN3 per MIL-C-5B	Timing capacitor for sweep on S1001, Figure 5-27
C1013		CAPACITOR, FIXED, MICA, 68 uuf, 5%, 500v type CM15C680JN3 per MIL-C-5B	Timing capacitor for sweep on S1001, Figure 5-27
C1015		Same as C312	Timing capacitor for sweep on S1001, Figure 5-27
DS402		LAMP, GLOW, (93519 type NE-2), T-2 clear bulb	Over Heat indicator, Figure 5-8
R10		RESISTOR, VARIABLE, composition, 100 ohms 10%, 2 watt, type RV4LAYSA101A per MIL-R-94B	Gain Adjust resistor, V2, Figure 6-2
R65		Same as R64	Cathode resistor for V5B, Figure 5-14
R178		RESISTOR, VARIABLE, composition, 25,000 ohms, 10%, 2 Watt, type RV4LAYSA253A per MIL-R-94B	Sweep Length Adj., Figure 6-3
R211		RESISTOR, VARIABLE, composition, 1000 ohms, 10%, 2 Watt, type RV4LAYSA102A per MIL-R-94B	Vernier Balance, Figure 6-3
R224		Same as R108	Parasitic Suppressor for V202B, Figure 5-21
R306		RESISTOR, VARIABLE, composition, 1.5 megohms, 10%, 2 Watt, type RV4LAYSA155A per MIL-R-94B	High Voltage Adj., Figure 6-2
R312		RESISTOR, VARIABLE, composition 100K ohms 10%, 2 Watt, type RV4LAYSA104A per MIL-R-94B	Astigmatism Control Figure 6-2
R425		RESISTOR, FIXED, COMPOSITION, 330 ohms, 10%, 1/2 Watt, type RC20GF331K per MIL-R-11C	Coupling Resistor for Q408, Figure 5-26
R443		RESISTOR, FIXED, COMPOSITION, 150 ohms, 10%, 1/2 Watt, type RC20GF151K per MIL-R-11C	Coupling Resistor for Q412, Figure 5-26
R462		Same as R443	Bias Voltage Divider Resistor for Q414, Figure 5-26
S101		SWITCH, ROTARY, 1 section, 4 position, (28569 #19912-513)	Trigger Source (A103) Figure 3-1
S102		SWITCH, ROTARY, 1 section, 2 position, (28569 #19912-514)	Trigger Slope (A100) Figure 3-1
S201		SWITCH, TOGGLE, SPST, type MS35058-22 per MIL-S-3950A	AC-DC, Figure 3-1
S202		SWITCH, ROTARY, 5 section, 16 position, (28569 #19912-527)	Horizontal Display, Figure 3-1, 5-18
S401		SWITCH, TOGGLE, bat handle, DPST, 20A at 115 VAC, 9A at 220 VAC, type MS35059-22 per MIL-S-3950A	Power Switch, Figure 3-1
S1001		SWITCH, ROTARY, 4 section, 24 position, 9 pole (28569 #19912-526)	Sweep Time/CM Switch, Figure 3-2

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
T301		TRANSFORMER, HIGH VOLTAGE, (28569 # 20800-296) (existing stk of 28569 # 20800-261 or 28480 #9110-0128-9 may be used)	High Voltage Power Supply, Figure 6-6
V102		LAMP, GLOW, type NE-76	Voltage dropping element for V101, Figure 5-16

MISCELLANEOUS PARTS

E301	- 1 -	POST, BINDING, red (58474#BB100-G4) or (28480 #HG-10G)	Calibrator Volts output binding post, Figure 3-1
E302	- 1 -	Same as E301	Calibrator Millivolts output binding post, Figure 3-1
E303	- 1 -	BINDING POST, black (58474#BB10035-G3) or (28480 #G-10C)	Calibrator ground binding post, Figure 3-1
E304	- 1 -	INSULATOR, BUSHING, (58474 #BB1038-G4) or (28480 #G-83G)	Insulator for E301
E305	- 1 -	Same as E304	Insulator for E302
E309	- 2 -	Same as E101	Calibrator Volts connector cover
E310	- 2 -	Same as E101	Calibrator Millivolts connector cover
J301	- 2 -	CONNECTOR, UG-657/U, per MIL-C-3608A	Calibrator Volts output connector, Figure 3-1
J302	- 2 -	Same as J301	Calibrator Millivolts output connector, Figure 3-1
MP-14		BEZEL, CRT (28569 #2330-31)	CRT Bezel, Figure 3-1

DUAL TRACE PREAMPLIFIER MX-2930A/USM-105A

L503		COIL, RF, 3.3 uh, 10%, 200 ma dc (99800 #1537-24)	Peaking Coil for V503A, Figure 5-29
R508		RESISTOR, VARIABLE, composition, 2500 ohms, 10%, 2 Watt, type RV4NAYSD252A per MIL-R-94B	Vernier Balance Adj. for Channel A, Figure 3-1
R571		Same as R561	Coupling Resistor for V503A, Figure 5-29
R572		Same as R561	Coupling Resistor for V503B, Figure 5-29
R573		Same as R561	Coupling Resistor for V506A, Figure 5-29
R574		Same as R561	Coupling Resistor for V506B, Figure 5-29
S502		SWITCH, ROTARY, 10 position, 2 section (28569 #19912-523)	Sensitivity Switch for Channel A, Figure 5-33
S506		SWITCH, ROTARY, 1 section, 2 position (28569 #19912-522) (includes R520)	Polarity Switch for Channel A, Figure 3-1

NOTE 1. This part used in equipments bearing serial number prefix letters "A" through "C", only.

NOTE 2. This part used in equipments bearing serial number prefix letter "D", only.

TEMPORARY CHANGE T-2 to TECHNICAL MANUAL for AN/USM-105A NAVSHIPS 0967-085-3010 (Formerly NAVSHIPS 93658A).

This temporary change revises the manual to reflect the equipment changes made by Field Change 0967-085-3050.

When this change is included in the manual, the manual shall cover the equipment as though Field Change 4-AN/USM-105A had been accomplished on the equipment. This change does not supersede any other changes or corrections.

Maintenance Support Activities shall make this change in the technical manual immediately, but shall keep the superseded data intact for support of equipments that have not been modified.

Holders of equipment accompanied by technical manuals shall not make this change in the manual until accomplishment of the field changes referenced above.

Insert this temporary change in the manual immediately after the front cover and preceding the title page or prior changes or temporary corrections in effect. Make pen-and-ink changes in the manual as follows:

Section 7, Table 71, Page 7-3

Ref. Desig.	Name and Description
B-401	Change to read: Motor, Direct Current, 18V, 2400 RPM

This correction appeared in EIB 683.

CHANGE 1 to NAVSHIPS 93658(A)

0967-085-3012
Formerly 0280-618-5005

30 July 1964

INSTRUCTION SHEET

CHANGE 1 to Technical Manual for Oscilloscope AN/USM-105A
NAVSHIPS 93658(A)

This permanent change revises the book to include supplementary and corrective information affecting the Maintenance Parts List, Section 7.

Maintenance Support Activities and holders of equipment accompanied by Technical Manuals shall insert this CHANGE in the technical manual immediately upon receipt.

1. Remove superseded pages and insert revised or supplementary pages as indicated below:

Page	Remove	Insert
TP/ii	Orig. /Orig.	Ch. 1/Ch. 1
---	---	SUPPLEMENTARY PARTS LIST, TABLE 7-1A (Pages 7A-1 through 7A-3) in front of the original PARTS LIST, TABLE 7-1.

2. Destroy superseded title pages but not before manual has been checked against the "List of Effective Pages" (Page ii CHANGE 1).

3. Insert this Instruction Sheet immediately behind the front cover of the manual.

NAVSHIPS 93658(A)

TECHNICAL MANUAL

for

OSCILLOSCOPE

AN/USM-105A

DEPARTMENT OF THE NAVY

BUREAU OF SHIPS

Contract: NObsr 85316 *Approved by BuShips: 31 October 1961*

N600(24)60141 **Change 1: 30 July 1964**

List of Effective Pages

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
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iii to ix	ORIGINAL	6-0 to 6-42	ORIGINAL
1-0 to 1-4	ORIGINAL	7A-1 to 7A-3	CHANGE 1
2-1	ORIGINAL	7-1 to 7-49	ORIGINAL
3-0 to 3-9	ORIGINAL		

SECTION 7A

SUPPLEMENTARY PARTS LIST

NOTE

"This parts list has been corrected by means of the following supplementary table. For any given item, always refer first to the appropriate supplementary table, since it completely supersedes any corresponding listing in the basic table. If no information is shown for a given item, refer to the basic table for the required information."

TABLE 7-1A SUPPLEMENTARY PARTS LIST

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C105		CAPACITOR, FIXED, MICA, 240 uf, 5% 500v, type CM15D241JN3 per MIL-C-5B	Bypass capacitor for V101 cathode, Figure 5-16
C107		CAPACITOR, FIXED, MICA, 33 uuf, 5%, 500V, type CM15C330JN3 per MIL-C-5B	Coupling capacitor for V104A, Figure 5-16
C108		CAPACITOR, FIXED, MICA, 75 uuf, 5%, 500V, type CM15C750JN3 per MIL-C-5B	Clamp capacitor for V103 cathode, Figure 5-16
C109		CAPACITOR, FIXED, MICA, 47 uuf, 5%, 500V, type CM15C470JN3 per MIL-C-5B	Coupling capacitor for V104B, Figure 5-16
C114		CAPACITOR, FIXED, MICA, 100 uuf, 5%, 500V, type CM15C101JN3 per MIL-C-5B	Coupling capacitor for V105A, Figure 5-16
C119		CAPACITOR, FIXED, MICA, 220 uuf, 5%, 500V, type CM15D221JN3 per MIL-C-5B	Decoupling capacitor for V105B grid, Figure 5-16
C124		CAPACITOR, FIXED, MICA, 68 uuf, 5%, 500V, (76433 #MCM15D680J)	Bypass capacitor for V109 plate, Figure 5-16
C132		CAPACITOR, FIXED, MICA, 390 uuf, 5%, 500V type CM15D391JN3 per MIL-C-5B	Bypass capacitor for arming input, Figure 5-16
C134		CAPACITOR, FIXED, MICA, 10 uuf, 5%, 500V type CM15B100KN3	Coupling capacitor for V114 grid, Figure 5-16
C302		CAPACITOR, FIXED, PAPER, molded plastic case, .0015 uf, 10%, 6000v, (09023 # PKM-60D15)	Bypass capacitor for V301A, Figure 5-24
C304		CAPACITOR, FIXED, MICA, 470 uuf, 5%, 500v type CM15D471JN3 per MIL-C-5B	Coupling capacitor for V302 grid, Figure 5-23
C306		CAPACITOR, FIXED, PAPER, molded plastic case, .0047 uf, 20%, 6000v, (09023 # PKM-60D47)	Filter capacitor for V303, Figure 6-6
C312		CAPACITOR, FIXED, MICA, 22 uuf, 5%, 500v type CM15C220JN3 per MIL-C-5B	Coupling capacitor for blanking to V305, Figure 5-24
C316		CAPACITOR, FIXED, MICA, 27 uuf, 5%, 500v type CM15C270JN3 per MIL-C-5B	Coupling capacitor for V306B, Figure 5-23
C403		CAPACITOR, FIXED, ELECTROLYTIC, 45 uf, 450v, -40°c to +85°c, type CE41 C45OR per MIL-C-62A	Bypass capacitor for CR401, CR402, CR403, CR404, Figure 5-25
C1009		CAPACITOR, FIXED, MICA, 1000 uuf, 2%, 500v, type CM20D102GN3 per MIL-C-5B	Timing capacitor for sweep time on S1001, Figure 5-27

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1011		CAPACITOR, FIXED, MICA, 82uuf, 5%, 500v type CM15C820JN3 per MIL-C-5B	Timing capacitor for sweep on S1001, Figure 5-27
C1013		CAPACITOR, FIXED, MICA, 68uuf, 5%, 500v type CM15C680JN3 per MIL-C-5B	Timing capacitor for sweep on S1001, Figure 5-27
C1015		Same as C312	Timing capacitor for sweep on S1001, Figure 5-27
DS402		LAMP, GLOW, (93519 type NE-2), T-2 clear bulb	Over Heat indicator, Figure 5-8
R10		RESISTOR, VARIABLE, composition, 100 ohms 10%, 2 watt, type RV4LAYSA101A per MIL-R-94B	Gain Adjust resistor, V2, Figure 6-2
R65		Same as R64	Cathode resistor for V5B, Figure 5-14
R178		RESISTOR, VARIABLE, composition, 25,000 ohms, 10%, 2 Watt, type RV4LAYSA253A per MIL-R-94B	Sweep Length Adj., Figure 6-3
R211		RESISTOR, VARIABLE, composition, 1000 ohms, 10%, 2 Watt, type RV4LAYSA102A per MIL-R-94B	Vernier Balance, Figure 6-3
R224		Same as R108	Parasitic Suppressor for V202B, Figure 5-21
R306		RESISTOR, VARIABLE, composition, 1.5 megohms, 10%, 2 Watt, type RV4LAYSA155A per MIL-R-94B	High Voltage Adj., Figure 6-2
R312		RESISTOR, VARIABLE, composition 100K ohms 10%, 2 Watt, type RV4LAYSA104A per MIL-R-94B	Astigmatism Control Figure 6-2
R425		RESISTOR, FIXED, COMPOSITION, 330 ohms, 10%, 1/2 Watt, type RC20GF331K per MIL-R-11C	Coupling Resistor for Q408, Figure 5-26
R443		RESISTOR, FIXED, COMPOSITION, 150 ohms, 10%, 1/2 Watt, type RC20GF151K per MIL-R-11C	Coupling Resistor for Q412, Figure 5-26
R462		Same as R443	Bias Voltage Divider Resistor for Q414, Figure 5-26
S101		SWITCH, ROTARY, 1 section, 4 position, (28569 #19912-513)	Trigger Source (A103) Figure 3-1
S102		SWITCH, ROTARY, 1 section, 2 position, (28569 #19912-514)	Trigger Slope (A100) Figure 3-1
S201		SWITCH, TOGGLE, SPST, type MS35058-22 per MIL-S-3950A	AC-DC, Figure 3-1
S202		SWITCH, ROTARY, 5 section, 16 position, (28569 #19912-527)	Horizontal Display, Figure 3-1, 5-18
S401		SWITCH, TOGGLE, bat handle, DPST, 20A at 115 VAC, 9A at 220 VAC, type MS35059-22 per MIL-S-3950A	Power Switch, Figure 3-1
S1001		SWITCH, ROTARY, 4 section, 24 position, 9 pole (28569 #19912-526)	Sweep Time/CM Switch, Figure 3-2

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
T301		TRANSFORMER, HIGH VOLTAGE, (28569 # 20800-296) (existing stk of 28569 # 20800-261 or 28480 #9110-0128-9 may be used)	High Voltage Power Supply, Figure 6-6
V102		LAMP, GLOW, type NE-76	Voltage dropping element for V101, Figure 5-16

MISCELLANEOUS PARTS

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E301	- 1 -	POST, BINDING, red (58474#BB100-G4) or (28480 #HG-10G)	Calibrator Volts output binding post, Figure 3-1
E302	- 1 -	Same as E301	Calibrator Millivolts output binding post, Figure 3-1
E303	- 1 -	BINDING POST, black (58474#BB10035-G3) or (28480 #G-10C)	Calibrator ground binding post, Figure 3-1
E304	- 1 -	INSULATOR, BUSHING, (58474 #BB1038-G4) or (28480 #G-83G)	Insulator for E301
E305	- 1 -	Same as E304	Insulator for E302
E309	- 2 -	Same as E101	Calibrator Volts connector cover
E310	- 2 -	Same as E101	Calibrator Millivolts connector cover
J301	- 2 -	CONNECTOR, UG-657/U, per MIL-C-3608A	Calibrator Volts output connector, Figure 3-1
J302	- 2 -	Same as J301	Calibrator Millivolts output connector, Figure 3-1
MP-14		BEZEL, CRT (28569 #2330-31)	CRT Bezel, Figure 3-1

DUAL TRACE PREAMPLIFIER MX-2930A/USM-105A

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L503		COIL, RF, 3.3 uh, 10%, 200 ma dc (99800 #1537-24)	Peaking Coil for V503A, Figure 5-29
R508		RESISTOR, VARIABLE, composition, 2500 ohms, 10%, 2 Watt, type RV4NAYSD252A per MIL-R-94B	Vernier Balance Adj. for Channel A, Figure 3-1
R571		Same as R561	Coupling Resistor for V503A, Figure 5-29
R572		Same as R561	Coupling Resistor for V503B, Figure 5-29
R573		Same as R561	Coupling Resistor for V506A, Figure 5-29
R574		Same as R561	Coupling Resistor for V506B, Figure 5-29
S502		SWITCH, ROTARY, 10 position, 2 section (28569 #19912-523)	Sensitivity Switch for Channel A, Figure 5-33
S506		SWITCH, ROTARY, 1 section, 2 position (28569 #19912-522) (includes R520)	Polarity Switch for Channel A, Figure 3-1

NOTE 1. This part used in equipments bearing serial number prefix letters "A" through "C", only.

NOTE 2. This part used in equipments bearing serial number prefix letter "D", only.

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TECHNICAL MANUAL

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OSCILLOSCOPE

AN/USM-105A

DEPARTMENT OF THE NAVY

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3-0 to 3-9	ORIGINAL		

SECTION 7A

SUPPLEMENTARY PARTS LIST

NOTE

"This parts list has been corrected by means of the following supplementary table. For any given item, always refer first to the appropriate supplementary table, since it completely supersedes any corresponding listing in the basic table. If no information is shown for a given item, refer to the basic table for the required information."

TABLE 7-1A SUPPLEMENTARY PARTS LIST

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C105		CAPACITOR, FIXED, MICA, 240 uf, 5% 500v, type CM15D241JN3 per MIL-C-5B	Bypass capacitor for V101 cathode, Figure 5-16
C107		CAPACITOR, FIXED, MICA, 33 uuf, 5%, 500V, type CM15C330JN3 per MIL-C-5B	Coupling capacitor for V104A, Figure 5-16
C108		CAPACITOR, FIXED, MICA, 75 uuf, 5%, 500V, type CM15C750JN3 per MIL-C-5B	Clamp capacitor for V103 cathode, Figure 5-16
C109		CAPACITOR, FIXED, MICA, 47 uuf, 5%, 500V, type CM15C470JN3 per MIL-C-5B	Coupling capacitor for V104B, Figure 5-16
C114		CAPACITOR, FIXED, MICA, 100 uuf, 5%, 500V, type CM15C101JN3 per MIL-C-5B	Coupling capacitor for V105A, Figure 5-16
C119		CAPACITOR, FIXED, MICA, 220 uuf, 5%, 500V, type CM15D221JN3 per MIL-C-5B	Decoupling capacitor for V105B grid, Figure 5-16
C124		CAPACITOR, FIXED, MICA, 68 uuf, 5%, 500V, (76433 #MCM15D680J)	Bypass capacitor for V109 plate, Figure 5-16
C132		CAPACITOR, FIXED, MICA, 390 uuf, 5%, 500V type CM15D391JN3 per MIL-C-5B	Bypass capacitor for arming input, Figure 5-16
C134		CAPACITOR, FIXED, MICA, 10 uuf, 5%, 500V type CM15B100KN3	Coupling capacitor for V114 grid, Figure 5-16
C302		CAPACITOR, FIXED, PAPER, molded plastic case, .0015 uf, 10%, 6000v, (09023 # PKM-60D15)	Bypass capacitor for V301A, Figure 5-24
C304		CAPACITOR, FIXED, MICA, 470 uuf, 5%, 500v type CM15D471JN3 per MIL-C-5B	Coupling capacitor for V302 grid, Figure 5-23
C306		CAPACITOR, FIXED, PAPER, molded plastic case, .0047 uf, 20%, 6000v, (09023 # PKM-60D47)	Filter capacitor for V303, Figure 6-6
C312		CAPACITOR, FIXED, MICA, 22 uuf, 5%, 500v type CM15C220JN3 per MIL-C-5B	Coupling capacitor for blanking to V305, Figure 5-24
C316		CAPACITOR, FIXED, MICA, 27 uuf, 5%, 500v type CM15C270JN3 per MIL-C-5B	Coupling capacitor for V306B, Figure 5-23
C403		CAPACITOR, FIXED, ELECTROLYTIC, 45 uf, 450v, -40°c to + 85°c, type CE41 C45OR per MIL-C-62A	Bypass capacitor for CR401, CR402, CR403, CR404, Figure 5-25
C1009		CAPACITOR, FIXED, MICA, 1000 uuf, 2%, 500v, type CM20D102GN3 per MIL-C-5B	Timing capacitor for sweep time on S1001, Figure 5-27

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1011		CAPACITOR, FIXED, MICA, 82uuf, 5%, 500v type CM15C820JN3 per MIL-C-5B	Timing capacitor for sweep on S1001, Figure 5-27
C1013		CAPACITOR, FIXED, MICA, 68uuf, 5%, 500v type CM15C680JN3 per MIL-C-5B	Timing capacitor for sweep on S1001, Figure 5-27
C1015		Same as C312	Timing capacitor for sweep on S1001, Figure 5-27
DS402		LAMP, GLOW, (93519 type NE-2), T-2 clear bulb	Over Heat indicator, Figure 5-8
R10		RESISTOR, VARIABLE, composition, 100 ohms 10%, 2 watt, type RV4LAYSA101A per MIL-R-94B	Gain Adjust resistor, V2, Figure 6-2
R65		Same as R64	Cathode resistor for V5B, Figure 5-14
R178		RESISTOR, VARIABLE, composition, 25,000 ohms, 10%, 2 Watt, type RV4LAYSA253A per MIL-R-94B	Sweep Length Adj., Figure 6-3
R211		RESISTOR, VARIABLE, composition, 1000 ohms, 10%, 2 Watt, type RV4LAYSA102A per MIL-R-94B	Vernier Balance, Figure 6-3
R224		Same as R108	Parasitic Suppressor for V202B, Figure 5-21
R306		RESISTOR, VARIABLE, composition, 1.5 megohms, 10%, 2 Watt, type RV4LAYSA155A per MIL-R-94B	High Voltage Adj., Figure 6-2
R312		RESISTOR, VARIABLE, composition 100K ohms 10%, 2 Watt, type RV4LAYSA104A per MIL-R-94B	Astigmatism Control Figure 6-2
R425		RESISTOR, FIXED, COMPOSITION, 330 ohms, 10%, 1/2 Watt, type RC20GF331K per MIL-R-11C	Coupling Resistor for Q408, Figure 5-26
R443		RESISTOR, FIXED, COMPOSITION, 150 ohms, 10%, 1/2 Watt, type RC20GF151K per MIL-R-11C	Coupling Resistor for Q412, Figure 5-26
R462		Same as R443	Bias Voltage Divider Resistor for Q414, Figure 5-26
S101		SWITCH, ROTARY, 1 section, 4 position, (28569 #19912-513)	Trigger Source (A103) Figure 3-1
S102		SWITCH, ROTARY, 1 section, 2 position, (28569 #19912-514)	Trigger Slope (A100) Figure 3-1
S201		SWITCH, TOGGLE, SPST, type MS35058-22 per MIL-S-3950A	AC-DC, Figure 3-1
S202		SWITCH, ROTARY, 5 section, 16 position, (28569 #19912-527)	Horizontal Display, Figure 3-1, 5-18
S401		SWITCH, TOGGLE, bat handle, DPST, 20A at 115 VAC, 9A at 220 VAC, type MS35059-22 per MIL-S-3950A	Power Switch, Figure 3-1
S1001		SWITCH, ROTARY, 4 section, 24 position, 9 pole (28569 #19912-526)	Sweep Time/CM Switch, Figure 3-2

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
T301		TRANSFORMER, HIGH VOLTAGE, (28569 # 20800-296) (existing stk of 28569 # 20800-261 or 28480 #9110-0128-9 may be used)	High Voltage Power Supply, Figure 6-6
V102		LAMP, GLOW, type NE-76	Voltage dropping element for V101, Figure 5-16

MISCELLANEOUS PARTS

E301	- 1 -	POST, BINDING, red (58474#BB100-G4) or (28480 #HG-10G)	Calibrator Volts output binding post, Figure 3-1
E302	- 1 -	Same as E301	Calibrator Millivolts output binding post, Figure 3-1
E303	- 1 -	BINDING POST, black (58474#BB10035-G3) or (28480 #G-10C)	Calibrator ground binding post, Figure 3-1
E304	- 1 -	INSULATOR, BUSHING, (58474 #BB1038-G4) or (28480 #G-83G)	Insulator for E301
E305	- 1 -	Same as E304	Insulator for E302
E309	- 2 -	Same as E101	Calibrator Volts connector cover
E310	- 2 -	Same as E101	Calibrator Millivolts connector cover
J301	- 2 -	CONNECTOR, UG-657/U, per MIL-C-3608A	Calibrator Volts output connector, Figure 3-1
J302	- 2 -	Same as J301	Calibrator Millivolts output connector, Figure 3-1
MP-14		BEZEL, CRT (28569 #2330-31)	CRT Bezel, Figure 3-1

DUAL TRACE PREAMPLIFIER MX-2930A/USM-105A

L503		COIL, RF, 3.3 uh, 10%, 200 ma dc (99800 #1537-24)	Peaking Coil for V503A, Figure 5-29
R508		RESISTOR, VARIABLE, composition, 2500 ohms, 10%, 2 Watt, type RV4NAYSD252A per MIL-R-94B	Vernier Balance Adj. for Channel A, Figure 3-1
R571		Same as R561	Coupling Resistor for V503A, Figure 5-29
R572		Same as R561	Coupling Resistor for V503B, Figure 5-29
R573		Same as R561	Coupling Resistor for V506A, Figure 5-29
R574		Same as R561	Coupling Resistor for V506B, Figure 5-29
S502		SWITCH, ROTARY, 10 position, 2 section (28569 #19912-523)	Sensitivity Switch for Channel A, Figure 5-33
S506		SWITCH, ROTARY, 1 section, 2 position (28569 #19912-522) (includes R520)	Polarity Switch for Channel A, Figure 3-1

NOTE 1. This part used in equipments bearing serial number prefix letters "A" through "C", only.

NOTE 2. This part used in equipments bearing serial number prefix letter "D", only.

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T-1 to NAVSHIPS 93658(A)

25 June 1964

UNCLASSIFIED

TEMPORARY CORRECTION T-2 TO TECHNICAL MANUAL FOR OSCILLOSCOPE AN/USM-105, NAVSHIPS 93482(A) AND TEMPORARY CORRECTION T-1 TO TECHNICAL MANUAL FOR OSCILLOSCOPE AN/USM-105A, NAVSHIPS 93658(A)

This temporary correction revises the manual to reflect the equipment change made by Field Change 2-AN/USM-105/2-AN/USM-105A/2-AN/USM-139. The purpose of this field change is to replace "Intensity Limit Adjust" potentiometer R325 with an insulated type to remove the high voltage personnel hazard. This field change applies to all AN/USM-105, AN/USM-105A, and AN/USM-139 oscilloscopes.

When this change is included in the manual, the manual shall cover the equipment as though Field Change 2-AN/USM-105/2-AN/USM-105A/2-AN/USM-139 had been accomplished on the equipment. This correction does not supersede any other corrections or changes.

Maintenance Support Activities shall make this correction in the technical manual immediately but shall keep the superseded data intact for support of equipments that have not been modified.

Holders of equipment accompanied by technical manuals shall not make this correction in the manual until accomplishment of the field change.

Make the following pen and ink corrections. Insert this temporary correction in the technical manual immediately after the front cover.

1. In Table 7-1, Maintenance Parts List (page 7-23 in NAVSHIPS 93658(A) for AN/USM-105A and AN/USM-139, page 7-30 in NAVSHIPS 93482(A) for AN/USM-105), delete all information relating to the old resistor (R325) and insert the following data in regard to the new resistor (R325) in the appropriate columns:

Ref. Desig.	Notes	Name and Description	Locating Function
R325		RESISTOR, VARIABLE, COMPOSITION: 1 megohm, 10%, 2 watt, linear taper, with 1/4" bushing, 1" high voltage standoff, and 9/16" insulated shaft (12697 series 53)	NAVSHIPS 93658(A): Intensity Limit Adjust, Figure 6-2 NAVSHIPS 93482(A): Intensity Limit Adjust, Figure 5-5

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NAVSHIPS 93658(A)

TECHNICAL MANUAL

for

OSCILLOSCOPE
AN/USM-105A

DEPARTMENT OF THE NAVY

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TITLE PAGE	CHANGE 1	4-0 to 4-6	ORIGINAL
ii	CHANGE 1	5-1 to 5-33	ORIGINAL
iii to ix	ORIGINAL	6-0 to 6-42	ORIGINAL
1-0 to 1-4	ORIGINAL	7A-1 to 7A-3	CHANGE 1
2-1	ORIGINAL	7-1 to 7-49	ORIGINAL
3-0 to 3-9	ORIGINAL		

DEPARTMENT OF THE NAVY
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From: Chief, Bureau of Ships
All Activities concerned with the Installation, Operation, and Maintenance of the Subject Equipment

Subj: Technical Manual for Oscilloscope AN/USM-105A, NAVSHIPS 93658A

1. This is the Technical Manual for the subject equipment and is in effect upon receipt. This manual superceeds NAVSHIPS 93658 which may be destroyed upon receipt of this manual.

2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.

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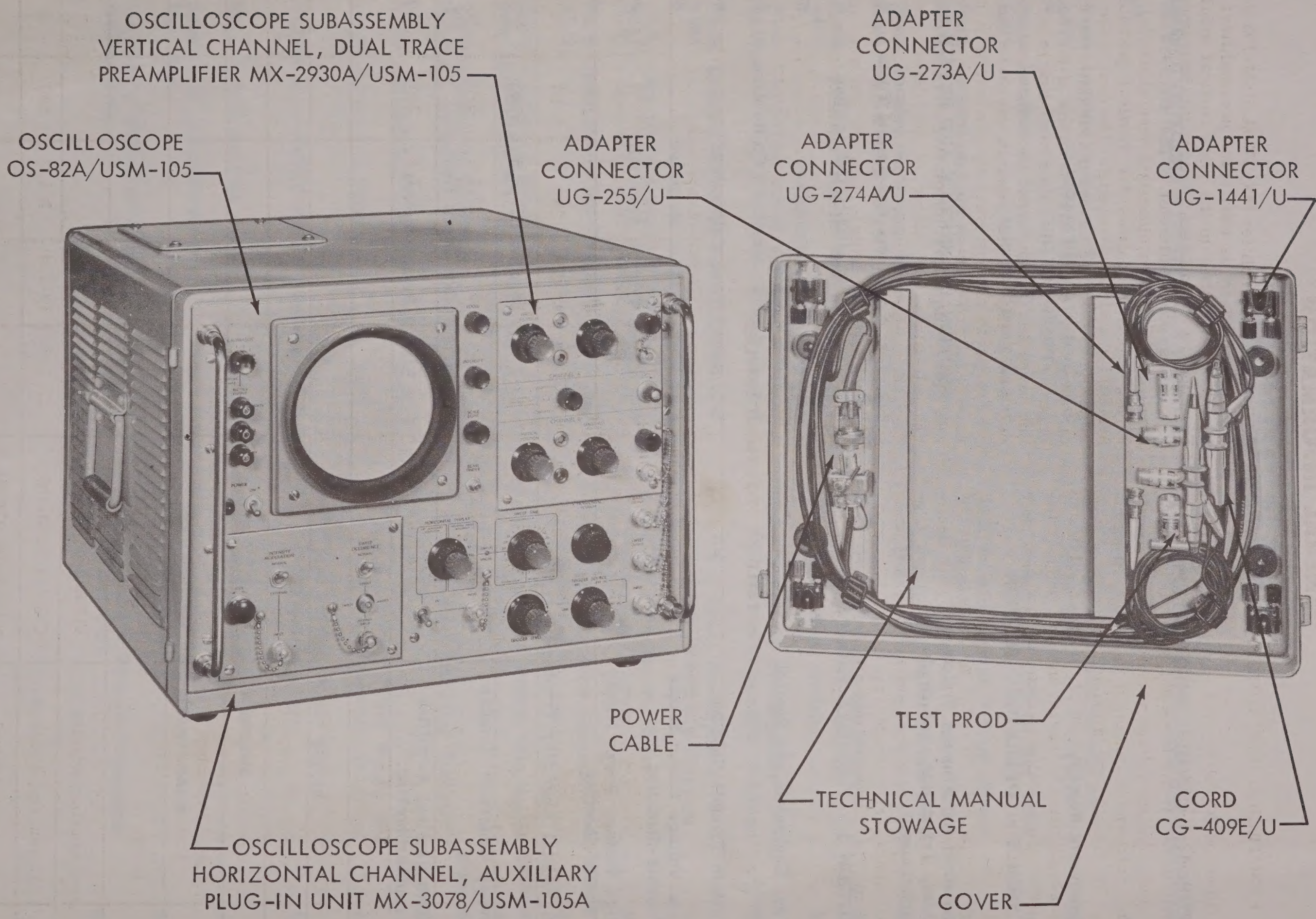

OSCILLOSCOPE SUBASSEMBLY
VERTICAL CHANNEL, DUAL TRACE
PREAMPLIFIER MX-2930A/USM-105
OSCILLOSCOPE
OS-82A/USM-105
ADAPTER
CONNECTOR
UG-255/U
ADAPTER
CONNECTOR
UG-274A/U
ADAPTER
CONNECTOR
UG-273A/U
ADAPTER
CONNECTOR
UG-1441/U
POWER
CABLE
TEST PROD
TECHNICAL MANUAL
STOWAGE
CORD
CG-409E/U
OSCILLOSCOPE SUBASSEMBLY
HORIZONTAL CHANNEL, AUXILIARY
PLUG-IN UNIT MX-3078/USM-105A
COVER

Figure 1-1 Oscilloscope AN/USM-105A

SECTION 1

GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION.

Oscilloscope AN/USM-105A is a general purpose, high-speed laboratory type oscilloscope designed for shipboard use. It produces a graphical display of simple and complex voltage variations which contain frequency components ranging from zero to 14 megacycles. To simplify operation and the interpretation of the display, the instrument provides calibrated vertical sensitivities, triggered internal sweeps, calibrated sweep times, calibrated expanded sweeps, beam finder, and calibrator.

Oscilloscope AN/USM-105A consists of a major unit and two plug-in units. The major unit, Oscilloscope OS-82A/USM-105, contains the power supplies, horizontal amplifier, sweep generator, main vertical amplifier, cathode ray tube (CRT), calibrator, and the controls associated with these circuits. Oscilloscope Subassembly, Vertical Channel, Dual Trace Preamplifier MX-2930A/USM-105 (hereafter referred to as dual trace preamplifier) is a plug-in preamplifier to the main vertical amplifier to extend the overall sensitivity of the instrument to 0.02 volts per centimeter. The dual trace preamplifier contains two identical input channels, each having separate controls for vertical positioning, sensitivity, and input coupling. The dual trace preamplifier is designed for use in four different modes of operation, (a) display of either of the two independent channels, (b) 'alternate' display whereby one sweep displays the input to one channel and the next sweep displays the input to the other channel, (c) 'chopped' display whereby one sweep is alternately switched between the output of the two channels, (d) a 'differential' display of the output of one channel minus the output of the other channel. Oscilloscope Subassembly, Horizontal Channel, Auxiliary Plug-in Unit MX-3078/USM-105A (hereafter referred to as auxiliary plug-in) permits single-sweep operation and external intensity modulation.

TABLE 1-1 EQUIPMENT SUPPLIED

Quant per Equip	Nomenclature		Overall Dimensions				
	Name	Designation	Height (inches)	Width (inches)	Depth (inches)	Volume (cu.inches)	Weight (lbs.)
1	Oscilloscope Assembly	AN/USM-105A	14-3/4	19-3/4	24	6700	96
1	Oscilloscope	OS-82A/USM-105	12-1/4	18	22-7/8	5100	68
1	Dual Trace Preamplifier	MX-2930A/USM-105	7	6	11-1/4	470	6
1	Auxiliary Plug-In	MX-3078/USM-105A	4-5/8	6	10-7/8	285	1.9
2	Prod, test	MX-2817/U					
2	Connector, adapter	UG-255/U					
2	Connector, adapter	UG-273/U					
4	Connector, adapter	UG-1441/U					
1	Cable Assembly, Power, Electrical	CX-4704/U (8 ft. 0 inch)					
2	Cord	CG-409E/U (8 ft. 0 inch)					
2	Connector, adapter	UG-274A/U					
1	Cover, Oscilloscope	CW-511/USM-105	12-1/2	19-3/4	2-1/2	580	8
2	Technical Manual	NAVSHIPS 93658A					

The instrument is cooled by a fan mounted at the rear of the instrument. A thermal relay protects the instrument against overheating by opening the main power circuit if the temperature within the cabinet exceeds 55° C (131° F).

1-2. FACTORY OR FIELD CHANGES.

This technical manual describes the equipment after incorporation of Field Change No. 1 to AN/USM-105A which modifies the main vertical amplifier. Figure 6-13 shows the difference between the present design and earlier equipments before incorporation of Field Change 1.

1-3. REFERENCE DATA.

Specifications for Oscilloscope AN/USM-105A are as follows:

TEMPERATURE AND HUMIDITY

This equipment is designed to operate within the accuracies specified herein over the entire temperature range from minus 28° to plus 50°C, with a relative humidity of 99 percent. When reference is made to temperature and humidity ranges of this paragraph the following shall apply: Range I shall be from plus 15° to plus 35°C, with relative humidity not greater than 75 percent; range II shall be from 0° to plus 50°C with a relative humidity not greater than 90 percent; range III shall be from minus 28° to plus 50°C with a relative humidity not greater than 99 percent.

EACH VERTICAL CHANNEL

Sensitivity Range:
0.02 volt/cm to 50 volts/cm. Ten calibrated ranges in 1, 2, 5, 10 sequence from 0.02 volt/cm to 20 volts/cm. Accuracy +3% except 5% over temperature and humidity range III. Vernier extends minimum sensitivity to at least 50 volts/cm.

Pass Band:
DC coupled: dc to 14 mc (3 db), 0.025 usec rise time.
AC coupled: 2 cps to 14 mc (3 db points)

Input Impedance:
1 megohm (nominal) shunted by 30 pf.

Polarity of Presentation:
+ up or - up, selectable.

Isolation:
At least 50 db isolation between the two vertical channels under any possible combination of attenuator controls and input signals.

Electronic Switching:
By alternate sweep or chopped at approximately 1 mc, with blanking during switching.

DIFFERENTIAL INPUT

Both input attenuators may be switched to one channel to give differential input. The input attenuators may be set separately to allow mixing signals of different levels.

Amplifier:
Channel A.

Common Mode Rejection:
At least 40 db at maximum sensitivity; at least 30 db when using attenuators.

SWEEP GENERATOR

Internal Sweep:
24 ranges, 0.1 usec/cm to 5 sec/cm; ±3%. Vernier extends slowest sweep to 15 sec/cm.

Magnification:
7 calibrated ranges, X1, X2, X5, X10, X20, X50, and X100. Increases fastest sweep speed to 0.02 usec/cm. X1, X2, and X5 ranges retain accuracy of original sweep, except 0.02 sec/cm rate which is 5%.

Triggering:
Internal, power line, or vertical input signal (1/2 cm or more vertical deflection). External (1/2 volts peak-to-peak or more).

Trigger Point:
Positive or negative going voltage. Trigger level of external trigger signal adjustable -30 to +30 volts.

Sweep Output:
- 50 to +50 volts approximately.

Gate Output:
+50 volts approximately, for duration of sweep.

HORIZONTAL AMPLIFIER

Pass Band:
DC coupled: dc to 1 mc (3 db).
AC coupled: 2 cps to 1 mc (3 db points)

Sensitivity:
7 ranges 0.1 volt/cm to 10 volts/cm. Vernier extends minimum sensitivity to 25 volts/cm.

Input Impedance:
1 megohm (nominal) shunted by 30 pf.

CALIBRATOR

Type:
1000 cycle square wave, 1 u sec rise and decay time.

Voltage:
9 calibrated ranges ±3%, 0.2 millivolts to 100 volts peak-to-peak.

Current:
5 milliamperes peak-to-peak, ±3%.

CATHODE RAY TUBE

Type:
5 AMP mono-accelerator, flat face, normally with P2 screen. 5000-volt accelerating potential.

Filter Supplied:
Compatible with phosphor, green with P2.

Graticule:
10 cm long x 6 cm high in centimeter squares; 2 mm subdivisions on horizontal and vertical axes. Controlled edge lighting.

Deflection Plate Connection:
Pin type terminals.

Deflection Sensitivity:
Vertical: approximately 20 volts/cm.
Horizontal: approximately 35 volts/cm.

Intensity Modulation:
+20 volt pulse blanks CRT trace of normal intensity.

GENERAL

Power Requirements:
115 vac ±10%, 47.5 to 440 cps, single phase, approximately 480 watts.

NOTES

SECTION 2

INSTALLATION

2-1. POWER REQUIREMENTS.

The AN/USM-105A operates from a power source of 115 volts ± 10%, single phase, 47.5 to 440 cps, which is capable of delivering approximately 500 watts.

An eight foot, three conductor power cable, CX-4704/U(8'0''), is supplied with the instrument. The cable terminates at one end in a female plug which mates with the connector on the rear of the instrument. The other end of the cable terminates in a polarized three-contact male plug. The third contact is an offset round pin which is added to a standard two-blade connector and grounds the instrument chassis when used with the appropriate receptacle. An adapter should be used to connect the polarized plug to a standard two-contact receptacle. When the adapter is used, the ground connection terminates in a short lead which should be connected to a suitable ground.

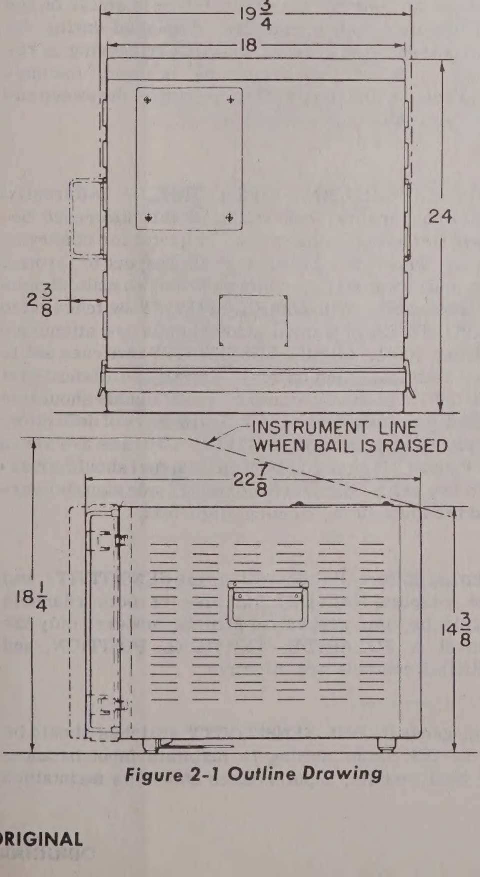


Figure 2-1 Outline Drawing

WARNING

If the adapter ground lead is not grounded, the instrument chassis and cabinet may assume an off-ground potential and create a hazard to operating personnel.

2-2. INSTALLATION REQUIREMENTS.

The AN/USM-105A is a portable instrument and does not require permanent installation. The instrument is intended to operate with the front panel in a vertical or near-vertical position. A forced draft cooling system maintains satisfactory operating temperature within the instrument case. Therefore, select a site providing at least two inches of clearance behind the instrument for the forced air cooling system to operate efficiently. Also, be sure other equipment does not discharge warm air into the air intake of the oscilloscope. Figure 2-2 gives overall dimensions of the instrument.

The air filter in the rear of the cabinet prevents dust and dirt from being drawn into the cabinet. It must be cleaned and re-coated periodically (refer to paragraph 6-2 for cleaning procedure). A dirty filter causes excessive internal temperatures resulting either in activating the thermal relay or decreased component life.

2-3. INSPECTION AND ADJUSTMENT.

Following installation, the instrument should be turned on and checked for proper operation.

a. INITIAL TURN ON. -

(1) Turn INTENSITY fully counterclockwise.

(2) Set HORIZONTAL DISPLAY to X1 and SWEEP TIME to .5 MILLISECONDS/CM.

(3) Center HORIZONTAL POSITION and VERTICAL POSITION controls.

(4) Turn POWER switch to ON and allow two minutes warm up.

(5) Rotate INTENSITY clockwise until trace of normal intensity appears. If CRT remains blank, press BEAM FINDER and readjust position controls as necessary.

(6) Adjust FOCUS for thin, well defined trace.

b. OPERATIONAL CHECK. - Check vertical sensitivity calibration and balance as described in paragraph 3-5, Operator's Maintenance. If little or no adjustment is required and the presentation otherwise appears normal, the instrument is operating properly. Should there be any indication of malfunction, see section 5 and 6 for trouble shooting and repair procedures.

SECTION 3
OPERATOR'S SECTION

3-1. FUNCTIONAL OPERATION.

Oscilloscope AN/USM-105A is a high-speed instrument which displays voltage variations ranging in frequency from dc to 14 megacycles. The voltage variations are displayed on the screen of a cathode ray tube (CRT). The instrument includes dual trace preamplifier MX-2930A/USM-105, the plug-in vertical preamplifier. The dual trace preamplifier has two identical signal channels and can accept two signals simultaneously. The two signals can be displayed independently, together in a dual trace presentation, or combined in a differential presentation.

Internal circuits provide a sweep which can be triggered or free run. Auxiliary plug-in unit MX-3078/USM-105A permits single sweep operation and external intensity modulation.

3-2. OPERATING PROCEDURES.

Personnel should become familiar with the controls and operating features of the AN/USM-105A before proceeding with tests and measurements. The front-panel controls and connectors are illustrated and described in figure 3-1. Some of the operating features are described below. For step-by-step operating procedures, see paragraph 3-4.

a. DC OR AC COUPLED INPUT. - The vertical and horizontal amplifiers of the AN/USM-105A are dc coupled. However, internal coupling capacitors can be switched into these circuits in series with the INPUT connectors to provide ac coupling as well. The dc coupling should be used for viewing long pulses and square waves below about 100 cps, since such signals are distorted by the time constant of the ac coupling circuit. Also, dc coupling should be used when the dc component is an important part of the signal. The ac coupling is intended for viewing ac components superimposed upon large dc voltages. Since the coupling capacitor blocks the dc component, sensitivity can be selected regardless of the dc level.

b. DUAL TRACE OPERATION. - Dual trace operation is intended for comparing two signals, such as input and output signals of an amplifier or network. The dual-trace preamplifier provides two types of dual trace operation: alternate and chopped. On alternate operation the dual-trace preamplifier connects the output of one channel to the CRT for the duration of one sweep and the output of the other channel for the duration of the next sweep. On chopped operation the dual-trace preamplifier switches channels at a one-megacycle rate, so both signals appear during each sweep.

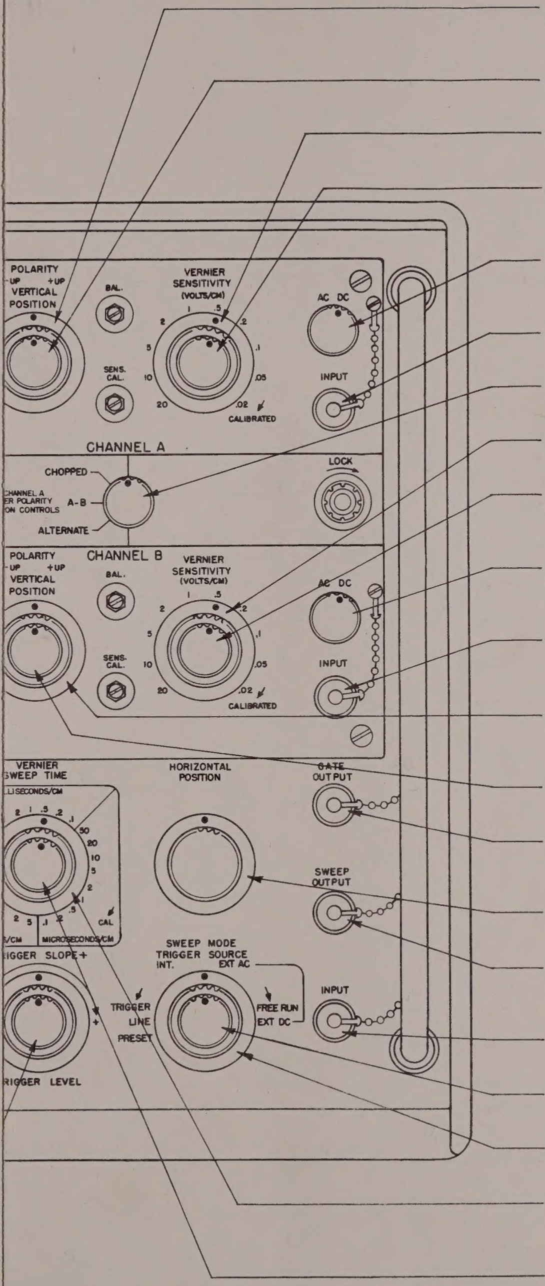
Alternate operation is intended for comparing signals which require high sweep speeds. However, for valid time comparisons, the sweeps must be triggered by an external trigger signal which is synchronized with both vertical signals. In many cases, one of the vertical signals can be used as the trigger signal as well.

Chopped operation is intended for comparing signals which require sweep speeds below about five microseconds/centimeter, sweep speeds which are low compared to the 1-megacycle switching rate. This type of operation permits precise time comparisons as long as the presentation is stable on the CRT because both signals are displayed during the same sweep. In general, external triggering is required. If internal triggering is used, the one-megacycle switching signal may trigger the sweep and cause an unstable presentation.

c. DIFFERENTIAL OPERATION. - Differential operation permits observation of the difference between two signal voltages and is useful for observing signals which are balanced with respect to ground. Hum and pickup signals common to the two main signals are attenuated. With both SENSITIVITY switches set to .02 VOLTS/CM, common mode signals are attenuated at least 100:1, with the SENSITIVITY switches set to other settings, common mode signals are attenuated at least 20:1. However, common mode signals should not exceed the equivalent of 100 centimeters of deflection; for example, if both SENSITIVITY switches are set to .02 VOLTS/CM, the common mode signal should not exceed two volts. Excessive common mode signals overload the amplifiers, causing distortion.

During differential operation, the SENSITIVITY and input coupling (AC-DC) switches of both channels operate on their respective signals; however only the Channel A POLARITY, VERTICAL POSITION, and VERNIER controls are effective.

In general, both SENSITIVITY switches should be set to the same setting to maintain input balance. For best results, input balance should be maintained


POLARITY
-UP +UP
VERTICAL
POSITION
BAL.
SENS.
CAL.
VERNIER
SENSITIVITY
(VOLTS/CM)
1
.5
2
.2
5
.1
10
.05
20
.02
CALIBRATED
AC DC
INPUT
CHANNEL A
LOCK
CHOPPED
HANNEL A
ER POLARITY
ON CONTROLS
A-B
ALTERNATE
CHANNEL B
VERNIER
SWEEP TIME
LLISECONDS/CM
HORIZONTAL
POSITION
GATE
OUTPUT
50
20
10
5
2
1
.5
CAL
S/CM
MICROSECONDS/CM
SWEEP
OUTPUT
IGGER SLOPE+
SWEEP MODE
TRIGGER SOURCE
INT.
EXT AC
TRIGGER
LINE
PRESET
FREE RUN
EXT DC
INPUT
RIGGER LEVEL

ADJUST VERTICAL POSITION OF CHANNEL A PRESENTATION

SELECT POLARITY OF CHANNEL A PRESENTATION

SELECT CALIBRATED CHANNEL A SENSITIVITY

ADJUST CHANNEL A SENSITIVITY BETWEEN CALIBRATED STEPS

SELECT DC OR AC COUPLING FOR CHANNEL A INPUT

CONNECT CHANNEL A INPUT

SELECT VERTICAL PRESENTATION

SELECT CALIBRATED CHANNEL B SENSITIVITY

ADJUST CHANNEL B SENSITIVITY BETWEEN CALIBRATED STEPS

SELECT DC OR AC COUPLING FOR CHANNEL B INPUT

CONNECT CHANNEL B INPUT

ADJUST VERTICAL POSITION OF CHANNEL B PRESENTATION

SELECT POLARITY OF CHANNEL B PRESENTATION

CRT UNBLANKING GATE (0 VOLTS BLANKED, APPROXIMATELY +50 VOLTS UNBLANKED)

ADJUST HORIZONTAL POSITION OF TRACE ON CRT

SWEEP OUTPUT (APPROXIMATELY −50 VOLTS TO + 50 VOLTS)

CONNECT EXTERNAL TRIGGER SIGNAL

SELECT TRIGGERED OR FREE-RUNNING SWEEP

SELECT TRIGGER SOURCE FOR INTERNAL SWEEP

SELECT CALIBRATED SWEEP TIME OF INTERNAL SWEEP

ADJUST SWEEP TIME BETWEEN CALIBRATED STEPS

SECTION 3
OPERATOR'S SECTION

3-1. FUNCTIONAL OPERATION.

Oscilloscope AN/USM-105A is a high-speed instrument which displays voltage variations ranging in frequency from dc to 14 megacycles. The voltage variations are displayed on the screen of a cathode ray tube (CRT). The instrument includes dual trace preamplifier MX-2930A/USM-105, the plug-in vertical preamplifier. The dual trace preamplifier has two identical signal channels and can accept two signals simultaneously. The two signals can be displayed independently, together in a dual trace presentation, or combined in a differential presentation.

Internal circuits provide a sweep which can be triggered or free run. Auxiliary plug-in unit MX-3078/USM-105A permits single sweep operation and external intensity modulation.

3-2. OPERATING PROCEDURES.

Personnel should become familiar with the controls and operating features of the AN/USM-105A before proceeding with tests and measurements. The front-panel controls and connectors are illustrated and described in figure 3-1. Some of the operating features are described below. For step-by-step operating procedures, see paragraph 3-4.

a. DC OR AC COUPLED INPUT. - The vertical and horizontal amplifiers of the AN/USM-105A are dc coupled. However, internal coupling capacitors can be switched into these circuits in series with the INPUT connectors to provide ac coupling as well. The dc coupling should be used for viewing long pulses and square waves below about 100 cps, since such signals are distorted by the time constant of the ac coupling circuit. Also, dc coupling should be used when the dc component is an important part of the signal. The ac coupling is intended for viewing ac components superimposed upon large dc voltages. Since the coupling capacitor blocks the dc component, sensitivity can be selected regardless of the dc level.

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c. DIFFERENTIAL OPERATION. - Differential operation permits observation of the difference between two signal voltages and is useful for observing signals which are balanced with respect to ground. Hum and pickup signals common to the two main signals are attenuated. With both SENSITIVITY switches set to .02 VOLTS/CM, common mode signals are attenuated at least 100:1, with the SENSITIVITY switches set to other settings, common mode signals are attenuated at least 20:1. However, common mode signals should not exceed the equivalent of 100 centimeters of deflection; for example, if both SENSITIVITY switches are set to .02 VOLTS/CM, the common mode signal should not exceed two volts. Excessive common mode signals overload the amplifiers, causing distortion.

During differential operation, the SENSITIVITY and input coupling (AC-DC) switches of both channels operate on their respective signals; however only the Channel A POLARITY, VERTICAL POSITION, and VERNIER controls are effective.

In general, both SENSITIVITY switches should be set to the same setting to maintain input balance. For best results, input balance should be maintained

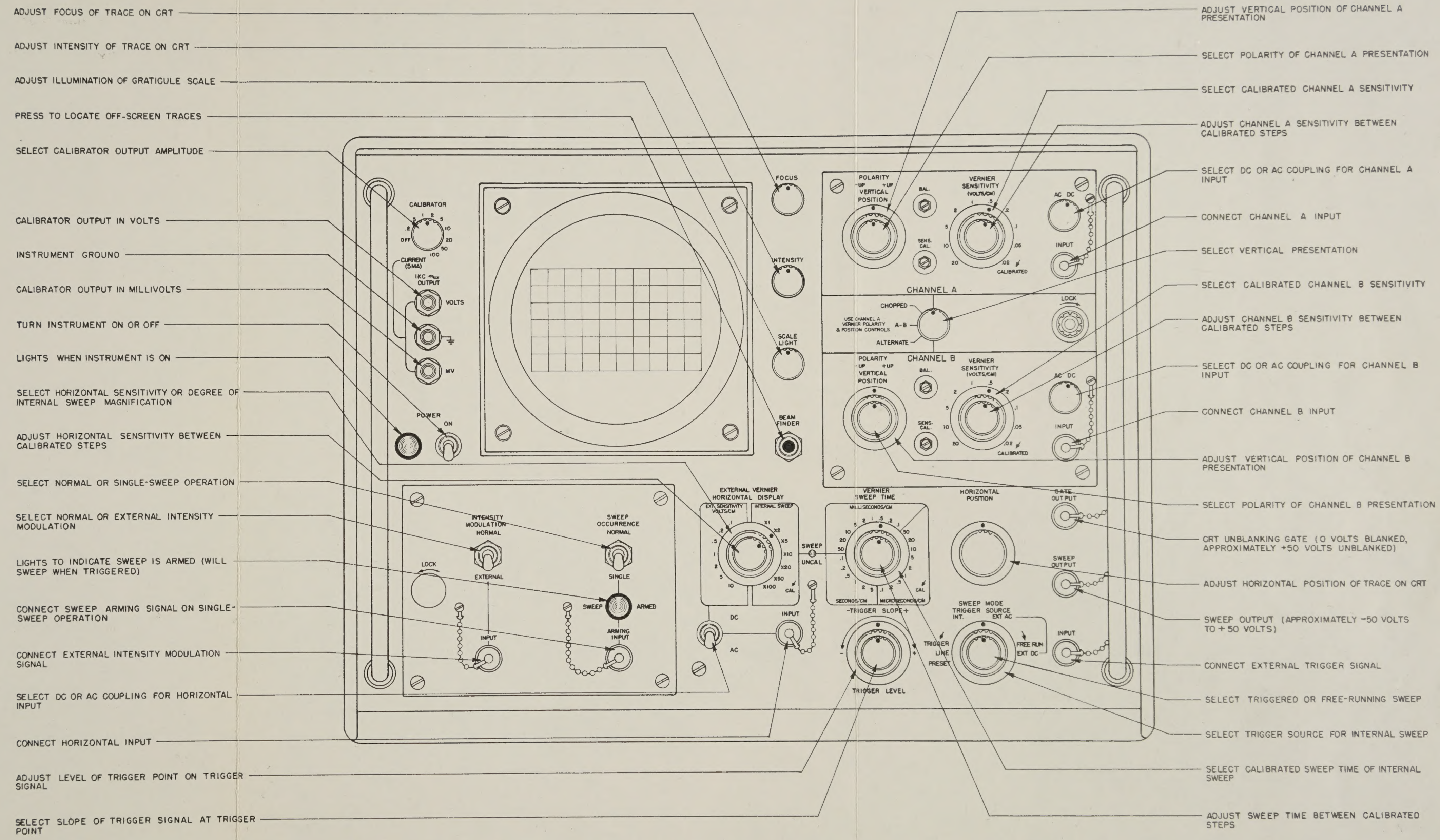

ADJUST FOCUS OF TRACE ON CRT
ADJUST INTENSITY OF TRACE ON CRT
ADJUST ILLUMINATION OF GRATICULE SCALE
PRESS TO LOCATE OFF-SCREEN TRACES
SELECT CALIBRATOR OUTPUT AMPLITUDE
CALIBRATOR OUTPUT IN VOLTS
INSTRUMENT GROUND
CALIBRATOR OUTPUT IN MILLIVOLTS
TURN INSTRUMENT ON OR OFF
LIGHTS WHEN INSTRUMENT IS ON
SELECT HORIZONTAL SENSITIVITY OR DEGREE OF INTERNAL SWEEP MAGNIFICATION
ADJUST HORIZONTAL SENSITIVITY BETWEEN CALIBRATED STEPS
SELECT NORMAL OR SINGLE-SWEEP OPERATION
SELECT NORMAL OR EXTERNAL INTENSITY MODULATION
LIGHTS TO INDICATE SWEEP IS ARMED (WILL SWEEP WHEN TRIGGERED)
CONNECT SWEEP ARMING SIGNAL ON SINGLE-SWEEP OPERATION
CONNECT EXTERNAL INTENSITY MODULATION SIGNAL
SELECT DC OR AC COUPLING FOR HORIZONTAL INPUT
CONNECT HORIZONTAL INPUT
ADJUST LEVEL OF TRIGGER POINT ON TRIGGER SIGNAL
SELECT SLOPE OF TRIGGER SIGNAL AT TRIGGER POINT
ADJUST VERTICAL POSITION OF CHANNEL A PRESENTATION
SELECT POLARITY OF CHANNEL A PRESENTATION
SELECT CALIBRATED CHANNEL A SENSITIVITY
ADJUST CHANNEL A SENSITIVITY BETWEEN CALIBRATED STEPS
SELECT DC OR AC COUPLING FOR CHANNEL A INPUT
CONNECT CHANNEL A INPUT
SELECT VERTICAL PRESENTATION
SELECT CALIBRATED CHANNEL B SENSITIVITY
ADJUST CHANNEL B SENSITIVITY BETWEEN CALIBRATED STEPS
SELECT DC OR AC COUPLING FOR CHANNEL B INPUT
CONNECT CHANNEL B INPUT
ADJUST VERTICAL POSITION OF CHANNEL B PRESENTATION
SELECT POLARITY OF CHANNEL B PRESENTATION
CRT UNBLANKING GATE (0 VOLTS BLANKED, APPROXIMATELY +50 VOLTS UNBLANKED)
ADJUST HORIZONTAL POSITION OF TRACE ON CRT
SWEEP OUTPUT (APPROXIMATELY −50 VOLTS TO + 50 VOLTS)
CONNECT EXTERNAL TRIGGER SIGNAL
SELECT TRIGGERED OR FREE-RUNNING SWEEP
SELECT TRIGGER SOURCE FOR INTERNAL SWEEP
SELECT CALIBRATED SWEEP TIME OF INTERNAL SWEEP
ADJUST SWEEP TIME BETWEEN CALIBRATED STEPS
CALIBRATOR
CURRENT (5MA)
1KC OUTPUT
VOLTS
MV
POWER
ON
FOCUS
INTENSITY
SCALE LIGHT
BEAM FINDER
POLARITY
VERTICAL POSITION
BAL.
SENS. CAL.
VERNIER SENSITIVITY (VOLTS/CM)
CALIBRATED
AC DC
INPUT
CHANNEL A
LOCK
CHOPPED
A-B
ALTERNATE
USE CHANNEL A VERNIER POLARITY & POSITION CONTROLS
CHANNEL B
INTENSITY MODULATION
NORMAL
EXTERNAL
SWEEP OCCURRENCE
SINGLE
SWEEP
ARMED
ARMING INPUT
EXTERNAL VERNIER
HORIZONTAL DISPLAY
EXT. SENSITIVITY VOLTS/CM
INTERNAL SWEEP
SWEEP UNCAL
DC
AC
VERNIER SWEEP TIME
MILLISECONDS/CM
SECONDS/CM
MICROSECONDS/CM
CAL
HORIZONTAL POSITION
GATE OUTPUT
SWEEP OUTPUT
-TRIGGER SLOPE+
TRIGGER
LINE
PRESET
TRIGGER LEVEL
SWEEP MODE
TRIGGER SOURCE
INT.
EXT AC
FREE RUN
EXT DC

Figure 3-1 Front Panel Controls and Connectors

external to the instrument as well.

d. SWEEP START SELECTION. - Four front-panel controls determine the mode of operation and starting point of the normal internal sweep. The controls are the TRIGGER SOURCE switch, the TRIGGER LEVEL control, the TRIGGER SLOPE switch, and the SWEEP MODE control.

The TRIGGER SOURCE switch selects the source of the trigger signal: the power line (LINE), the signal applied to the dual-trace preamplifier (INT), or an external signal applied to the trigger source INPUT (EXT AC or EXT DC).

The TRIGGER LEVEL control adjusts the voltage level on the trigger signal at which the sweep starts. The control provides continuous adjustment of the trigger level from about -30 volts to about +30 volts on external trigger signals and over a range equivalent to about six centimeters of vertical deflection on the CRT on external trigger signals.

The TRIGGER SLOPE switch determines whether the sweep starts on the positive-slope or negative-slope portion of the trigger signal.

The SWEEP MODE control determines whether the sweep requires a trigger or runs free. The control is continuously adjustable with a switched position at its counterclockwise extreme. The switched position, PRESET, is the best overall setting for the control when the trigger signal is below about 10 megacycles. This position is internally set for optimum triggered operation. For trigger signals above 10 megacycles, free-run operation may be better. In this case the trigger signal synchronizes the sweep with the signal being viewed. For very high frequency trigger signals, a fine adjustment of the SWEEP MODE and/or TRIGGER LEVEL controls may be necessary to stabilize the presentation on the CRT.

e. SINGLE SWEEP OPERATION. - Single-sweep operation is intended for viewing transients and other one-shot signals and also aperiodic signals which can not be viewed using normal triggered-sweep operation. In single-sweep operation, the sweep generator is disabled at the end of each sweep and must be armed before it can generate another. The sweep generator can be armed automatically with an external signal or manually by rotating the SWEEP MODE control just out of PRESET.

f. BEAM FINDER. - The BEAM FINDER is a push-button switch which, when pressed, limits maximum beam deflection to the edge of the CRT. Thus the BEAM FINDER helps locate traces which are normally deflected off the screen. When the switch is pressed, the beam is confined to the face of the CRT, brightened, and also defocused to prevent accidental burning of the CRT face. The trace can be centered with the horizontal and vertical position controls while the BEAM FINDER is pressed; the trace will then remain on screen when the switch is released.

g. CALIBRATOR. - An internal calibrator provides a 1-kc voltage square wave calibrated in volts and millivolts peak-to-peak and a 1-kc current square wave 5 milliamperes peak-to-peak. The calibrator output can be used to check vertical and horizontal sensitivities and to match the test prods or other external coupling devices to a particular input.

h. TEST PROD. - The test prods are used to decrease circuit loading. The one megohm input impedance of the vertical and horizontal circuits plus the shunt capacity of a cable connecting the oscilloscope to the test circuit may degrade the operation of the circuit under test. The test prod increases input impedance to ten megohms shunted by ten picofarads. The test prod also introduces a 10:1 voltage division which must be considered when translating waveform deflection on the CRT into volts.

The test prod has an adjustable compensating capacitance so the prod can be matched exactly to a particular input of the oscilloscope. The procedure for matching a test prod to the Channel A input of the dual-trace preamplifier is given below. The procedure is similar for matching a test prod to any other input.

(1) Connect test prod cable to Channel A INPUT.

(2) Select CHANNEL A and set Channel A SENSITIVITY switch to .02 VOLTS/CM.

(3) Set SWEEP TIME switch to .5 MILLISECONDS/CM, HORIZONTAL DISPLAY switch to X1, TRIGGER SOURCE switch to INT, and SWEEP MODE control to PRESET.

(4) Set CALIBRATOR switch to 1 and touch test prod to VOLTS terminal of calibrator output. A square wave five centimeters high should appear on the CRT.

(5) Loosen knurled locknut just behind rear flange on test prod body.

(6) Hold test prod behind locknut and rotate rear flange to give flat-topped square wave.

(7) Tighten knurled locknut without distrubing adjustment. This completes adjustment.

3-3. SUMMARY OF OPERATING INSTRUCTIONS.

The following procedures give step-by-step operating instructions for Oscilloscope AN/USM-105A. The first procedure gives complete instructions for single-channel operation. The remaining procedures give instructions peculiar only to the modes of operation with which they are concerned.

Before making any test or measurements, allow the instrument about five minutes warm up.

CAUTION

Rotate INTENSITY control fully counterclockwise before turning instrument on to prevent accidental burning of the CRT face during warm up.

Use the test prods and other accessories furnished with the oscilloscope as necessary.

a. SINGLE TRACE OPERATION - INTERNAL SWEEP.

(1) Connect vertical signal to INPUT of Channel A.

(2) Set Vertical Presentation switch to CHANNEL A.

(3) Set SENSITIVITY switch for Channel A as desired. (Set VERNIER to CALIBRATED for calibrated sensitivity.)

(4) Set input coupling for AC or DC coupling as desired.

(5) Set POLARITY switch to +UP or -UP as desired.

(6) Set TRIGGER SOURCE as desired. If external trigger is used, connect it to trigger source INPUT.

(7) Set INTENSITY MODULATION and SWEEP OCCURRENCE switches to NORMAL.

(8) Set HORIZONTAL DISPLAY switch to INTERNAL SWEEP X1.

(9) Set SWEEP MODE to PRESET.

(10) Set TRIGGER SLOPE switch for triggering on positive or negative slope of trigger signal as desired.

(11) Set TRIGGER LEVEL control to 0.

(12) Set SWEEP TIME switch for desired sweep time (set VERNIER control to CAL for calibrated sweep time).

(13) Set INTENSITY control as desired.

(14) Adjust VERTICAL POSITION and HORIZONTAL POSITION controls as desired.

(15) If trace does not appear on screen, press BEAM FINDER switch and readjust position controls to center trace.

(16) Adjust TRIGGER LEVEL control to start trace at desired level of trigger signal. It may be necessary to switch SWEEP MODE control from PRESET and select a better setting for the particular trigger signal being used.

Note

To use Channel B for single trace operation follow the above procedure except to substitute Channel B controls and terminals for the Channel A controls and terminals called out in the procedure.

b. DUAL TRACE OPERATION.

(1) Connect one signal to INPUT connector of Channel A and set Channel A controls as desired.

(2) Connect second signal to INPUT of Channel B and set Channel B controls as desired.

(3) Set Vertical Presentation switch to CHOPPED for display of both signals on same sweep, to ALTERNATE for display of signals on alternate sweeps.

Note

For best results, use external triggering.

c. DIFFERENTIAL OPERATION.

(1) Connect one signal to INPUT of Channel A.

(2) Set SENSITIVITY switch of Channel A as desired.

(3) Connect second signal to INPUT of Channel B.

(4) For best results, set SENSITIVITY of Channel B to same setting as SENSITIVITY of Channel A.

(5) Set POLARITY switch of Channel A to +UP.

(6) Set Vertical Presentation switch to A-B.

(7) If vertical adjustment is necessary, use VERTICAL POSITION control of Channel A.

d. INTERNAL SWEEP MAGNIFICATION.

(1) Set SWEEP TIME switch as desired (set VERNIER control to CAL for calibrated sweep time).

(2) Set HORIZONTAL DISPLAY switch to INTERNAL SWEEP X1 (unmagnified sweep position).

(3) Adjust HORIZONTAL POSITION control to place portion of trace to be magnified under vertical center line of graticule.

(4) Set HORIZONTAL DISPLAY to desired magnification.

(5) Readjust INTENSITY as necessary.

(6) If selected sweep time with magnification is less than minimum calibrated sweep time (0.02 microseconds/cm), SWEEP UNCAL indicator will light indicating that sweep time is no longer calibrated.

e. EXTERNAL HORIZONTAL INPUT.

(1) Connect horizontal signal to horizontal INPUT connector.

(2) Set horizontal input coupling switch to AC or DC as desired.

(3) Set HORIZONTAL DISPLAY to desired external sensitivity.

(4) Adjust HORIZONTAL POSITION control as desired.

f. INTENSITY MODULATION.

(1) Set INTENSITY MODULATION switch to EXTERNAL.

(2) Connect modulation signal to external intensity modulation INPUT connector. Positive signal of 20 volts peak will blank trace from normal intensity; negative signal will brighten trace.

g. SINGLE SWEEP OPERATION.

(1) Set SWEEP OCCURRENCE switch to NORMAL.

(2) Set SWEEP TIME switch as desired (set VERNIER control to CAL for calibrated sweep time).

(3) Set TRIGGER SOURCE switch according to trigger signal used.

(4) Set SWEEP MODE as desired.

(5) Set TRIGGER SLOPE as desired.

(6) Adjust TRIGGER LEVEL as desired.

(7) Set SWEEP OCCURRENCE to SINGLE.

(8) To arm sweep circuit, switch SWEEP MODE just out of PRESET and back to PRESET, or apply pulse 1 to 4 microseconds long and +15 to +25 volts peak to ARMING INPUT connector.

(9) SWEEP ARMED indicator will light. After sweep, indicator will extinguish, and sweep circuit will remain disabled until rearmed.

h. CONNECTING SIGNAL DIRECTLY TO CRT DEFLECTION PLATES.

CAUTION

Do not contact CRT deflection plate terminals with instrument turned on. These terminals are normally operated about +200 volts.

(1) Turn oscilloscope off and remove access plate on top of cabinet.

(2) Remove leads from vertical deflection plate terminals D3 and D4. See figure 3-2.

(3) Connect components as shown in figure 3-2. Use capacitors with good high-frequency response, such as C103 listed in table 7-1. Front-panel VERTICAL POSITION control remains effective.

(4) For single-ended input, ground common signal lead as shown by dashed ground lead in figure 3-2. For balanced input leave both signal leads ungrounded.

(5) Turn oscilloscope on. Use external signal to trigger sweep.

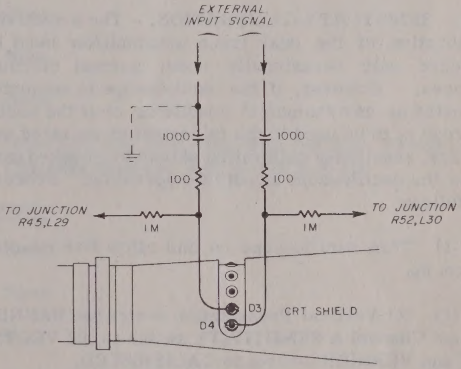
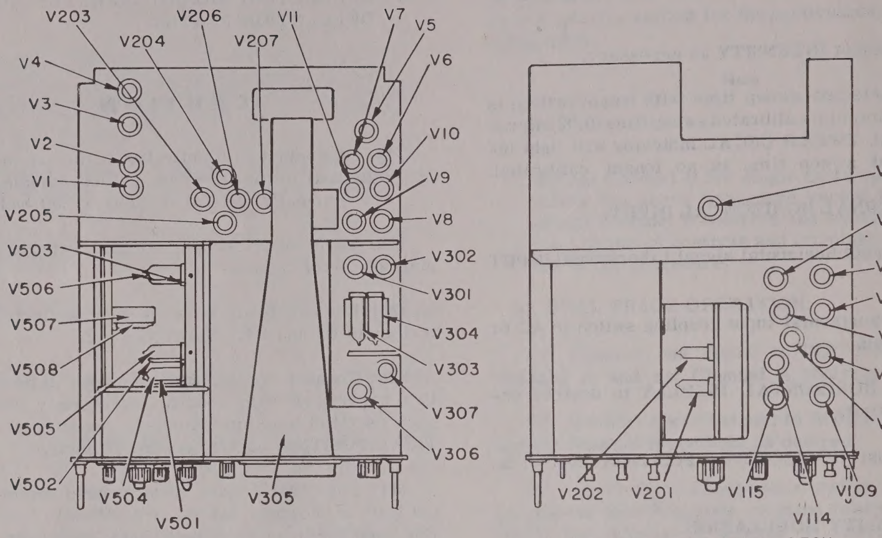


Figure 3-2 Direct Connection to Cathode Ray Tube

3-4. OPERATOR'S MAINTENANCE.

Maintenance by operating personnel is normally limited to checking and, when necessary, adjusting the sensitivity calibration and balance of the dual trace preamplifier and to cleaning the air filter. (see section 6.) Operating personnel can also replace electron tubes in those circuits which will not require subsequent adjustment. (See table 3-1.) Only a technician should replace tubes in a circuit which may then require adjustment. (See table 3-1.)



BOTTOM VIEW OF TOP DECK

TOP VIEW OF BOTTOM DECK

Figure 3-3 Location of Electron Tubes

a. SENSITIVITY CALIBRATION. - The sensitivity calibration of the dual trace preamplifier need be checked only occasionally under normal circumstances. However, if the oscilloscope is subjected to extreme environmental conditions or if the oscilloscope is to be used to the full extent of its rated accuracy, sensitivity calibration should be checked each time the oscilloscope is put into operation. Proceed as follows:

(1) Turn oscilloscope on and allow five minutes warm up.

(2) Set Vertical Presentation switch to CHANNEL A; set Channel A SENSITIVITY switch to .02 VOLTS/CM and VERNIER control to CALIBRATED.

(3) Set HORIZONTAL DISPLAY switch to X1, SWEEP TIME switch to .5 MILLISECONDS/CM, TRIGGER SOURCE switch to INT, and SWEEP MODE control to PRESET.

(4) Set CALIBRATOR switch to 100 and connect MV terminal of calibrator output to Channel A INPUT. (If test prod is used, set CALIBRATOR switch to 1 and connect test prod to VOLTS terminal of calibrator output.)

(5) Approximately five cycles of a square wave should appear on CRT. Adjust Channel A SENS CAL control (on front panel) to make square wave exactly five centimeters high.

(6) Repeat for Channel B.

b. BALANCE. - Balance is properly set when there is no vertical shift of the presentation on the CRT when the POLARITY switch is switched between +UP and -UP. The adjustment is not critical and need be set only when the shift of the presentation is enough to be annoying. Proceed as follows:

(1) Set Vertical Presentation switch to CHANNEL A and SWEEP MODE control to FREE RUN.

(2) Vertically center sweep with Channel A VERTICAL POSITION control.

(3) Adjust Channel A BAL control (on front panel) for minimum vertical shift of trace as Channel A POLARITY switch is switched from +UP to -UP.

(4) Repeat for Channel B.

c. REPLACEMENT OF FUSES. - The fuses for the +110 volt and -100 volt power supplies plus spare fuses for these supplies are located behind the auxiliary plug-in unit. The line fuses and the other power supply fuses plus a spare fuse for each are located behind the dual trace preamplifier plug-in unit.

d. OVERHEAT PROTECTION. - The oscilloscope has a thermal switch which opens the main power circuit when the temperature within the cabinet exceeds 55°C (131°F). If the instrument suddenly goes off after operating normally, check the overheat indicator, a neon lamp located on the fuse bracket behind the dual trace preamplifier plug-in unit. Remove the dual trace preamplifier without turning off the

POWER switch. If the lamp is lighted, the instrument is overheated. Turn off the POWER switch and remove the cause of overheating. The thermal switch will automatically reclose the main power circuit when the temperature lowers to about 49°C (120° F). Before returning the instrument to service be sure the fan operates.

e. **EMERGENCY MAINTENANCE. - In an emergency, operating personnel can replace tubes and semiconductor devices listed in table 3-1. Overall operation of the oscilloscope will not be seriously degraded. However, a technician should check the indicated adjustment as soon as possible thereafter.**

TABLE 3-1 REQUIRED ADJUSTMENTS FOLLOWING TUBE, TRANSISTOR, AND DIODE REPLACEMENT

Tube or Transistor	Function	Adjustment
	Main Vertical Amplifier	
CR1	Breakdown Diode	**Main Vertical Amplifier Gain per par. 6-11a**
CR2	Breakdown Diode	**Main Vertical Amplifier Gain per par. 6-11a**
V1	Cathode Follower	None
V2	Input Amplifier	Main Vertical Amplifier Gain and High Frequency **Compensation per par. 6-11a & 6-11b**
V3	Cathode Follower	None
V4	Internal Trigger Amplifier/ Cathode Follower	None
V5	Cathode Follower	None
V6	Cathode Follower Driver	None
V7	Cathode Follower Driver	None
V8 through V11	Output Amplifier	Main Vertical Amplifier Gain and High Frequency **Compensation per par. 6-11a & 6-11b**
	Sweep Generator	
CR101	Clamp	None
CR102	Limiter	None
CR103	Limiter	None
CR104	Switch Diode	**Sweep Time Calibration per par. 6-10d**
V101	Trigger Amplifier	**Trigger Symmetry per par. 6-10b**
V103	Trigger Generator	None
V104	Gate Generator	Preset
V105	Gate Generator/Clamp	Preset
V107	Cathode Follower	None
V109	Integrator	**Sweep Time Calibration per par. 6-10d**
V113	Bias Control Cathode Follower	None
V114	Cathode Follower	None
V115	Output Cathode Follower	None

TABLE 3-1 REQUIRED ADJUSTMENTS FOLLOWING TUBE, TRANSISTOR, AND DIODE REPLACEMENT

Tube or Transistor	Function	Adjustment
	Horizontal Amplifier	
Q201/202	Differential Amplifier	All Horizontal Amplifier Adjustments per par. 6-9
V201	External Input Cathode Follower/ Input Cathode Follower	External Vernier Balance per par. 6-9c
V202	Cathode Follower	X100 Gain and Balance per par. 6-9b & 6-9c
V203	Cathode Follower	None
V204/205	Differential Amplifier	All Horizontal Amplifier Adjustments per par. 6-9
V206	Output Cathode Follower	None
V207	Capacitance Driver	Capacitance Driver per par. 6-9e
	High Voltage Power Supply	
V301	Regulator	None
V302	R. F. Oscillator	None
V303	H. V. Rectifier	None
V304	H. V. Rectifier	None
V305	CRT	All Main Vertical Amplifier and Horizontal per par. 6-9 & 6-10. Amplifier Adjustments
	Calibrator	
V306	Multivibrator	None
V307	Clamp Diode/Disconnect Diode	None
	Low Voltage Power Supplies	
CR401 through CR412	Rectifier	None
CR413	Reference Diode	None
CR414/415	Rectifier	None
CR416	Reference	6.3 Volt Supply
Q401 through Q419	Amplifiers, Emitter Followers, Regulators	None
	Dual Trace Preamplifier	
CR501 through CR506	Coupling, Clamp Diodes	None

TABLE 3-1 REQUIRED ADJUSTMENTS FOLLOWING TUBE, TRANSISTOR, AND DIODE REPLACEMENT

Tube or Transistor	Function	Adjustment
	Dual Trace Preamplifier (Continued)	
Q501/502	Differential Amplifier	Sensitivity Calibration and Vernier Balance, Channel A per par. 6-12a & 6-12b
Q503/504	Differential Amplifier	Sensitivity Calibration and Vernier Balance, Channel B per par. 6-12a & 6-12b
V501	Cathode Follower	Vernier Balance, Channel A per par. 6-12a
V502	Transistor Driver	Sensitivity Calibration and Vernier Balance, Channel A per par. 6-12a & 6-12b
V503	Output Cathode Follower	None
V504	Cathode Follower	Vernier Balance, Channel B per par 6-12a
V505	Transistor Driver	Sensitivity Calibration and Vernier Balance, Channel B per par. 6-12a & 6-12b
V506	Output Cathode Follower	None
V507	Amplifier/Cathode Follower	None
V508	Switching Multivibrator	Multivibrator Frequency per par. 6-12g
	Auxiliary Plug-in	
CR1	Limiter	None

SECTION 4

PRINCIPLES OF OPERATION

4-1. OVERALL FUNCTIONAL DESCRIPTION.

Oscilloscope AN/USM-105A produces a visible pattern which is a graphical picture of applied voltage variations. The pattern appears on the face of a CRT. Figure 4-1 is an overall block diagram of the oscilloscope, and as shown, the main functional sections are 1) dual trace preamplifier, 2) main vertical amplifier, 3) sweep generator, 4) horizontal amplifier, 5) high voltage power supply, 6) calibrator, and 7) low voltage power supplies.

a. DUAL TRACE PREAMPLIFIER. - The dual trace preamplifier receives the vertical input signals amplifies them, and applies them to the main vertical amplifier. The preamplifier has two identical amplifier channels and a switch which connects one channel or the other to the main vertical amplifier.

b. MAIN VERTICAL AMPLIFIER. - The main vertical amplifier amplifies the signals received from the dual trace preamplifier and applies the signals to the vertical deflection plates of the CRT. The main vertical amplifier also applies part of the vertical signal to the sweep generator for internal triggering of the sweep.

c. SWEEP GENERATOR. - The sweep generator generates a linearly rising voltage (sweep) which is used to drive the CRT beam horizontally across the CRT screen for internal sweep operation. The sweep generator thus provides a linear time base on which to measure the vertical signals. The generator can be operated as a triggered or free-running circuit.

d. HORIZONTAL AMPLIFIER. - The horizontal amplifier amplifies the sweep signal or external horizontal signals and applies them to the horizontal deflection plates of the CRT.

e. CALIBRATOR. - The calibrator generates a square wave of about one kilocycle for checking the calibration of the vertical and horizontal amplifiers and for matching the test prods to particular input channels.

f. HIGH VOLTAGE POWER SUPPLY. - The high voltage power supply generates the high voltages required by the CRT circuit for proper operation.

g. LOW VOLTAGE POWER SUPPLIES. - The low voltage power supplies provide the operating voltages required by the various circuits throughout the oscilloscope and plug-in units. All dc voltages provided by the supplies (except to the fan) are regulated.

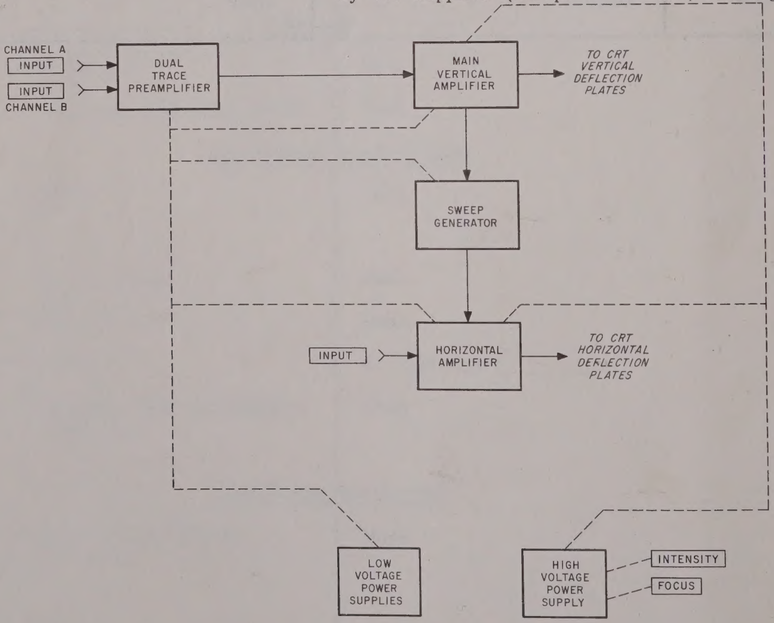

CHANNEL A
INPUT
INPUT
CHANNEL B
DUAL TRACE PREAMPLIFIER
MAIN VERTICAL AMPLIFIER
TO CRT VERTICAL DEFLECTION PLATES
SWEEP GENERATOR
INPUT
HORIZONTAL AMPLIFIER
TO CRT HORIZONTAL DEFLECTION PLATES
LOW VOLTAGE POWER SUPPLIES
HIGH VOLTAGE POWER SUPPLY
INTENSITY
FOCUS

Figure 4-1 Overall Block Diagram

4-2. DUAL TRACE PREAMPLIFIER.

Figure 4-2 is a block diagram of the dual trace preamplifier. The output signals from both channels are applied to the main vertical amplifier. However, switching multivibrator V508 controls the differential amplifiers in such a way that only one is turned on at a time. Thus only the signal applied to the "on" differential amplifier is amplified and applied to the main vertical amplifier. The "off" differential amplifier blocks the signal applied to it.

Except when switching, one plate of multivibrator V508 is positive and the other is negative. Diodes between the plates of the multivibrator and the differential amplifiers connect the plates to the amplifiers when the plates are positive and disconnect the plates from the amplifiers when the plates are negative. When one of the multivibrator plates is positive, then, it raises the common-base voltage of the transistors in its associated differential amplifier. The voltage is high enough to reverse bias the emitter-base junctions of the transistors and cut them off. When a multivibrator plate is negative, it is disconnected from its associated amplifier and that amplifier operates normally.

The front-panel Vertical Presentation switch determines the action of multivibrator V508. With the switch set to CHANNEL A or A-B, the multivibrator is held in the state in which it turns on the Channel A differential amplifier and turns off the Channel B differential amplifier. With the switch set to CHANNEL B, the multivibrator is held in its other state, turning off the Channel A amplifier and turning on the Channel B amplifier. With the switch set to CHOPPED, the switching multivibrator free runs at a rate of about 1 mc, turning alternate amplifiers on and off at this rate. To prevent switching transients from appearing on the CRT during CHOPPED operation, a negative pulse, generated by the multivibrator while switching, is applied to amplifier/cathode follower V507. The resulting positive pulse is applied to the CRT cathode to blank the presentation during multivibrator switching time. With the Vertical Presentation switch set to ALTERNATE, the switching multivibrator is converted into a bistable circuit. The multivibrator is switched from one state to the other at the end of each sweep by the differentiated unblanking gate from the sweep generator. This signal is applied to amplifier/cathode follower V507 and then to the multivibrator.

With the Vertical Presentation switch set to CHANNEL A, only signals applied to Channel A appear on the CRT. The input signal is applied to a frequency-

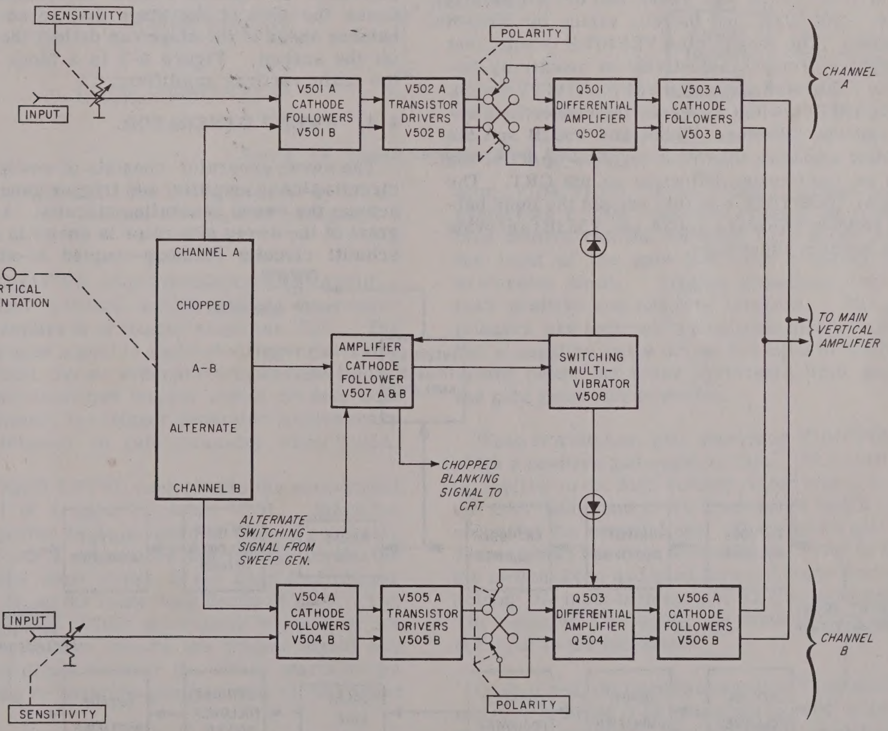

SENSITIVITY
INPUT
V501 A CATHODE FOLLOWERS V501 B
V502 A TRANSISTOR DRIVERS V502 B
POLARITY
Q501 DIFFERENTIAL AMPLIFIER Q502
V503 A CATHODE FOLLOWERS V503 B
CHANNEL A
VERTICAL PRESENTATION
CHANNEL A
CHOPPED
A-B
ALTERNATE
CHANNEL B
AMPLIFIER CATHODE FOLLOWER V507 A & B
SWITCHING MULTI-VIBRATOR V508
TO MAIN VERTICAL AMPLIFIER
CHOPPED BLANKING SIGNAL TO CRT.
ALTERNATE SWITCHING SIGNAL FROM SWEEP GEN.
INPUT
V504 A CATHODE FOLLOWERS V504 B
V505 A TRANSISTOR DRIVERS V505 B
Q503 DIFFERENTIAL AMPLIFIER Q504
V506 A CATHODE FOLLOWERS V506 B
CHANNEL B
POLARITY
SENSITIVITY

Figure 4-2 Dual Trace Preamplifier Block Diagram

compensated attenuator which determines the calibrated sensitivity of the channel. The attenuated signal is applied to cathode follower V501A. The input to cathode follower V501B is grounded. The output signals from V501A and V501B are connected to transistor drivers V502A and V502B and then to differential amplifier Q501/Q502. The differential amplifier amplifies the difference between these two signals. The output of the differential amplifier is a signal which is balanced to ground; that is, the signal must be measured between corresponding points on each side of the amplifier, not between one side and ground. The balanced signal from the differential amplifier is applied to cathode followers V503A and V503B and then to the main vertical amplifier.

The SENS CAL control calibrates the gain of Channel A by adjusting the amount of current drawn by transistor drivers V502A and V502B, for the current drawn by the transistor drivers determines their transconductance, and the transconductance of the transistor drivers in turn determines the gain obtained from differential amplifier Q501/Q502. The BAL control compensates for unbalance in the channel and main vertical amplifier by setting the balance of transistor drivers V502A and V502B. The VERNIER control varies the series resistance between transistor drivers V502A and V502B and the differential amplifier Q501/Q502 and thereby varies the gain of the channel. The range of the VERNIER is sufficient to provide continuous adjustment of sensitivity between the calibrated steps of the SENSITIVITY switch. The POLARITY switch reverses the connections between cathode followers V502A and V502B and the differential amplifier to provide negative-up deflection as well as positive-up deflection on the CRT. The VERTICAL POSITION control adjusts the input balance of cathode followers V503A and V503B to provide vertical position adjustment.

The operation of Channel B is identical to that of Channel A.

On A-B (differential) operation, the Channel B input signal is applied through the Channel B attenuator to cathode follower V501B of Channel A. Thus only the Channel A amplifier is used for differential operation.

4-3. MAIN VERTICAL AMPLIFIER.

The main vertical amplifier is a conventional balanced amplifier (see schematic diagram Figure 6-13). The amplifier receives the balanced signal from the dual trace preamplifier, amplifies it, and drives the vertical deflection plates of the CRT. The circuit includes delay lines which delay the signal passing through the amplifier. The undelayed signal from one side of the amplifier is taken off, amplified, and applied to the TRIGGER SOURCE switch in the sweep generator for internal triggering of the sweep by the vertical signal. The delay lines provide enough delay (0.25 μsec) so that when internal triggering is used, the sweep generator is triggered and the sweep started before the vertical signal is applied to the CRT deflection plates.

The BEAM FINDER switch is in the cathode circuit of the output amplifier. When pressed, the switch increases the common cathode resistance and so reduces the gain of the stage that no amount of unbalance ahead of the stage can deflect the CRT beam off the screen. Figure 4-3 is a block diagram of the main vertical amplifier.

4-4. SWEEP GENERATOR.

The sweep generator consists of sweep generating circuits plus an amplifier and trigger generator which actuate the sweep generating circuits. A block diagram of the sweep generator is shown in figure 4-3. Schmitt circuits (cathode-coupled bi-stable multi-

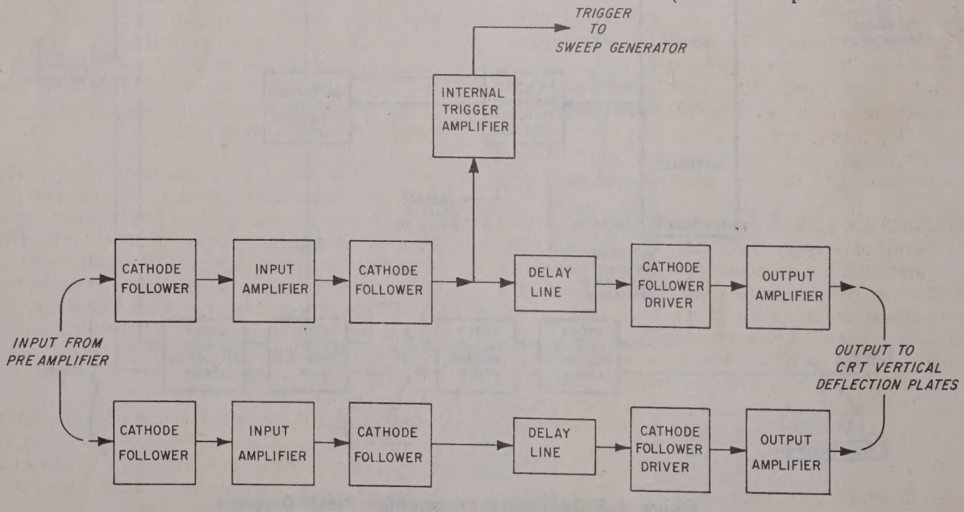


Figure 4-3 Main Vertical Amplifier Block Diagram

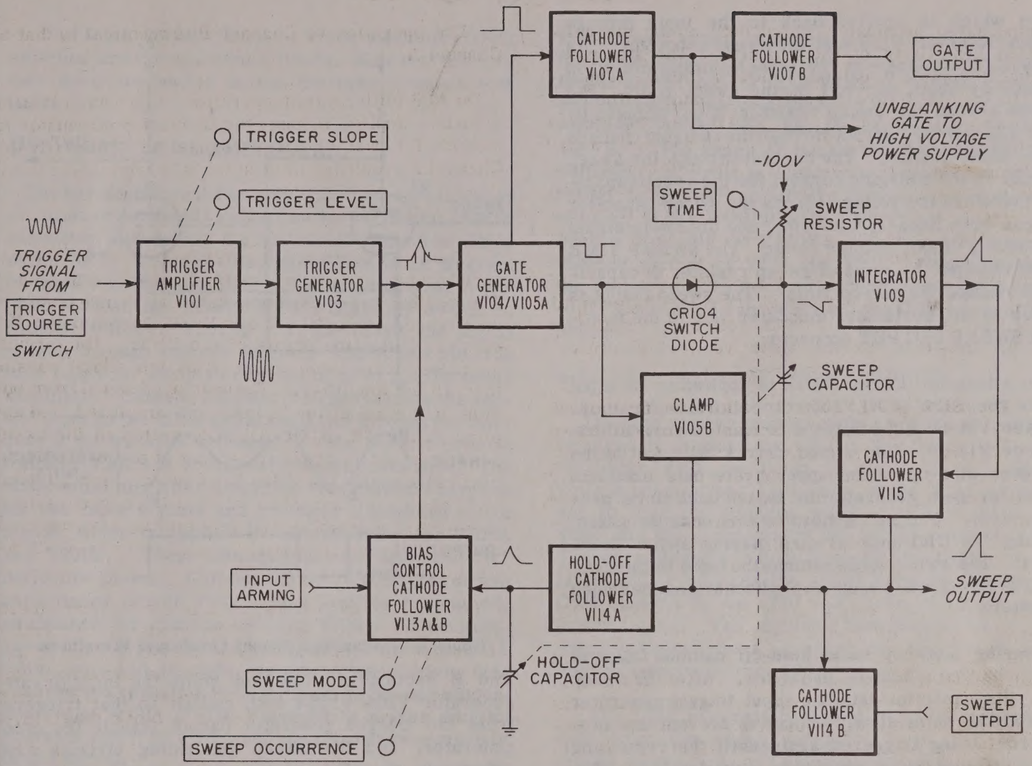

CATHODE FOLLOWER V107A
CATHODE FOLLOWER V107B
GATE OUTPUT
UNBLANKING GATE TO HIGH VOLTAGE POWER SUPPLY
TRIGGER SLOPE
TRIGGER LEVEL
-100V
SWEEP TIME
SWEEP RESISTOR
TRIGGER SIGNAL FROM
TRIGGER SOUREE
SWITCH
TRIGGER AMPLIFIER V101
TRIGGER GENERATOR V103
GATE GENERATOR V104/V105A
INTEGRATOR V109
CR104 SWITCH DIODE
SWEEP CAPACITOR
CLAMP V105B
CATHODE FOLLOWER V115
INPUT ARMING
BIAS CONTROL CATHODE FOLLOWER V113A&B
HOLD-OFF CATHODE FOLLOWER V114A
SWEEP OUTPUT
HOLD-OFF CAPACITOR
SWEEP MODE
SWEEP OCCURRENCE
CATHODE FOLLOWER V114B
SWEEP OUTPUT

Figure 4-4 Sweep Generator Block Diagram

vibrators) are used in the sweep generator; for a discussion of the Schmitt circuit, see paragraph d below.

a. AMPLIFIER AND TRIGGER GENERATOR. - The TRIGGER SOURCE switch selects the trigger signal and applies it to trigger amplifier V101. The amplified trigger signal is applied to trigger generator V103, a Schmitt circuit with narrow hysteresis limits. Provided the amplified trigger signal crosses both hysteresis limits, the trigger generator applies sharp pulses or triggers to gate generator V104/V105A.

The TRIGGER LEVEL control sets the zero-signal output level of trigger amplifier V101. Since the trigger amplifier is dc coupled to trigger generator V103, the control determines the voltage levels the trigger signal must cross if the amplified trigger signal is to cross the hysteresis limits of V103. The TRIGGER SLOPE switch determines whether or not the trigger amplifier inverts the trigger signal and thereby determines whether the sweep starts on the positive-going or negative-going portion of the trigger signal.

b. SWEEP GENERATING CIRCUITS. - Gate generator V104/V105A is a Schmitt circuit with wide hysteresis limits. Between sweeps, the A section of bias control cathode follower V113 holds the bias at the input of the gate generator close to the lower hysteresis limit. Trigger generator V103 applies both positive and negative triggers. The positive triggers are reduced in amplitude and have no effect, but a negative pulse drives the input to the gate generator below the lower hysteresis limit and causes the gate generator to switch.

When it switches, gate generator V104/V105A provides a positive and negative gate. The positive gate is applied to the high voltage power supply to turn on the CRT beam and to the front-panel GATE OUTPUT connector for external use. The negative gate applies reverse bias to switch diode CR104. Prior to the gate, the switch diode had been forward biased and had been holding the input to integrator V109 at about zero volts. The negative gate opens the diode switch and frees the input to the integrator.

Once freed, the input to integrator V109 starts going negative because it is connected to -100 volts through the sweep resistor. The integrator amplifies and inverts its input to produce a large, positive-going output which is applied back to the input through cathode follower V115 and the sweep capacitor. As a result, the voltage at the input to integrator V109 changes by about one volt during sweep time. The voltage across the sweep resistor, then, changes by about 1%, and the current through the resistor changes by the same amount. The current through the sweep resistor is the charging current for the sweep capacitor; therefore the voltage across the sweep capacitor changes quite linearly with time, and the sweep signal is a nearly linear voltage ramp. The SWEEP TIME switch changes the value of sweep resistor or capacitor to change the sweep time. The sweep output is applied to the horizontal amplifier and to the front-panel SWEEP OUTPUT connector.

An attenuated sweep signal is applied to the input of gate generator V104/V105A through hold-off cathode follower V114A and section B of bias control cathode follower V113. This signal drives the input of the gate generator up to the upper hysteresis limit and causes the gate generator to switch back to its pre-sweep state. The gate generator then ends the gates, blanking the CRT and forward biasing switch diode CR104. The switch diode returns the input to integrator V109 to its pre-sweep level, discharging the sweep capacitor.

During a sweep time, hold-off cathode follower V114A charges a hold-off capacitor. After the sweep ends, this capacitor lets the input to gate generator V104/V105A down slowly enough to prevent that circuit from being triggered again until the remaining sweep circuits have recovered completely. The SWEEP TIME switch changes the size of the hold-off capacitor with sweep time.

Clamp V105B insures that each sweep starts from the same voltage level, about -50 volts.

The SWEEP MODE control determines the no-signal bias at the input to gate generator V104/V105A by setting the bias on the A section of bias control cathode follower V113. With the control set to PRESET or in the TRIGGER portion of its adjustable range, the gate generator bias cannot drop below its lower hysteresis limit unless trigger generator provides a trigger. With the control set in the FREE RUN portion of its adjustable range, the gate bias is allowed to drop below its lower hysteresis limit. Thus as the hold-off capacitor discharges, it lets the gate generator bias all the way down to the lower hysteresis limit, and another sweep starts automatically.

c. SINGLE SWEEP OPERATION. - The SWEEP OCCURRENCE switch selects normal or single-sweep operation. Normal operation is discussed above. For single-sweep operation, the SWEEP OCCURRENCE switch converts V113 into a Schmitt circuit. As the sweep signal from hold-off cathode follower V114A rises to end the gate from the gate generator, the sweep signal also switches the Schmitt circuit of V113 so that V113B conducts and V113A is cut off. The B section of V113 then holds the input to gate generator V104/V105A high enough so that triggers from the trigger generator cannot actuate the gate generator, and the sweep generating circuits are effectively disabled. A positive signal applied to V113A switches the Schmitt circuit of V113 so that V113A conducts and V113B is cut off. The A section of V113 then sets the input to the gate generator according to the setting of the SWEEP MODE control, and the sweep generating circuits are effectively armed. The switching signal for V113A can be an external signal applied to the ARMING INPUT connector or an internal signal obtained from the SWEEP MODE control when the control is rotated just out of PRESET.

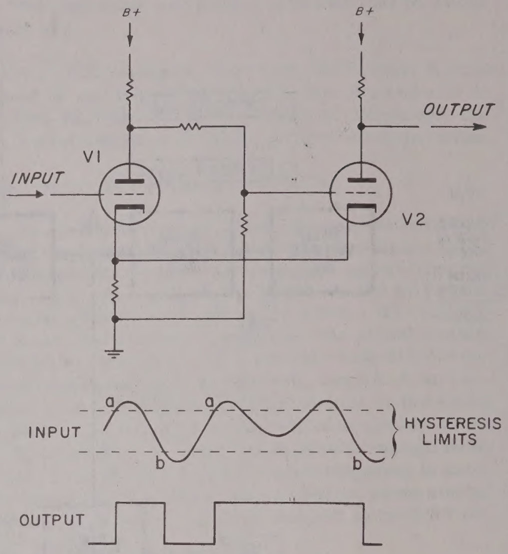


Figure 4-5 Simplified Schmitt Circuit and Waveforms

d. SCHMITT CIRCUIT. - The Schmitt circuit is a form of bi-stable multivibrator used where fast-rising signals are required. Figure 4-5 shows a simplified Schmitt circuit and input and output waveforms. If initially the input voltage is such that V1 is cut off, V2 conducts. As the input voltage becomes more positive, it will eventually reach a predetermined level (a) at which the circuit changes state; V1 conducts and V2 is cut off. If the input voltage then goes negative, the common cathode potential decreases and V2 grid goes positive. When the input reaches a second predetermined level (b), V2 conducts and the circuit switches back to its initial state. The output of the circuit is a voltage step, either positive or negative depending upon the slope of the input. In the case of trigger generator V103, a differentiating network differentiates the voltage steps into short pulses.

The input voltage levels at which a Schmit circuit switches are the hysteresis limits. Note that the circuit does not switch unless the input crosses both limits.

4-5. HORIZONTAL AMPLIFIER.

The horizontal amplifier amplifies the internal sweep or an external signal applied to the horizontal INPUT connector and drives the horizontal deflection plates of the CRT. Figure 4-6 is a simplified block diagram of the horizontal amplifier. The sweep signal is applied through the HORIZONTAL DISPLAY switch to cathode follower V201A. From V201A the signal passes through cathode follower V202A and one side of a balanced attenuator to one input of a differential amplifier. Cathode follower V202B controls the second input to the differential amplifier through the other side of the balanced attenuator. The input to cathode follower V202B is grounded through a resistance. The differential amplifier amplifies the difference between its two input signals and provides a balanced output signal, which is applied to cathode followers V206A and V206B. These cathode followers drive the CRT deflection plates. Cathode follower V206B also drives capacitance driver V207, which acts as the cathode resistance for cathode follower V206A. When high-speed signals such as the faster sweeps drive the CRT beam from left to right, the capacitance driver discharges the capacitance of the deflection plate associated with V206A. The capacitance driver thereby prevents cutoff in V206A and the resulting degradation of the signal.

External horizontal signals applied to the INPUT connector pass through an attenuator, cathode follower V201B, and the HORIZONTAL DISPLAY switch to cathode follower V201A. Otherwise the operation is the same as described above for the sweep signal.

The HORIZONTAL DISPLAY switch selects the signal to be applied to the horizontal deflection plates. The switch also controls the input attenuator and the balanced attenuator. The balanced attenuator provides a means of sweep expansion and in combination with the input attenuator provides steps of external horizontal sensitivity. The EXTERNAL VERNIER control varies the series resistance in the output of cathode follower V201B and thereby varies the output of V201B. The range of the EXTERNAL VERNIER is sufficient to provide continuous adjustment of external horizontal sensitivity between the calibrated settings of the HORIZONTAL DISPLAY switch. A section of the BEAM FINDER switch is in the common cathode circuit of V204 and V205. When pressed, the switch reduces the gain so that an unbalance prior to V204 and V205 cannot deflect the CRT beam off the screen.

4-6. HIGH VOLTAGE POWER SUPPLY.

The high voltage power supply provides the voltage required to operate the CRT. See figure 4-7. RF oscillator V302 oscillates at about 50 kc. High-voltage transformer T301 steps up the oscillator output to high ac voltages which rectifiers V303 and V304 and their associated RC filters convert to dc. The dc voltages are then applied to the CRT. Regulator V301 compares the -4800 volts supplied to the CRT cathode to the +370 volts from the low voltage power supply. The regulator then changes the amplitude of rf oscillations to oppose any change in the high voltage relative to the +370 volts.

The CRT is normally biased off. The unblanking gate from the sweep generator turns the CRT on during sweep time and external horizontal operation.

The INTENSITY control permits limited adjustment of the voltage supplied to the CRT control grid. A section of the BEAM FINDER is in the CRT cathode supply. When pressed, the switch returns the cathode supply to -100 volts instead of to ground. Regulator V301 reduces the amplitude of rf oscillations to keep the cathode supply at -4800 volts but at the same time reduces the voltage supplied to the control grid. With its bias reduced, the CRT turns on.

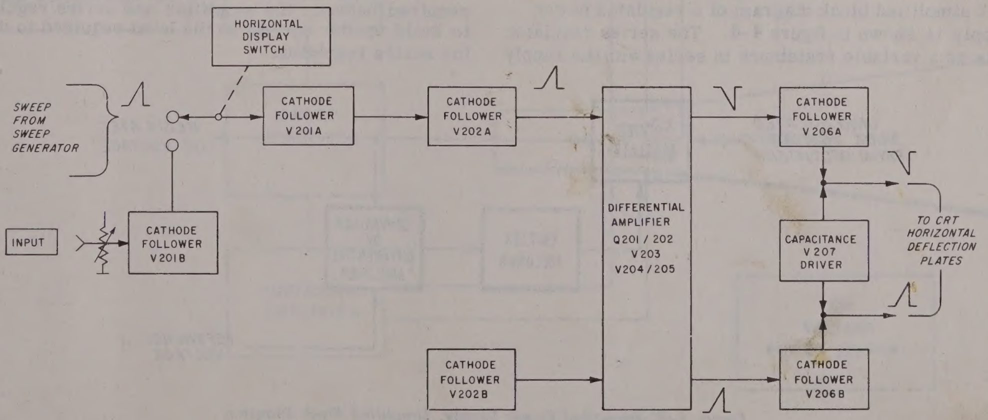


Figure 4-6 Horizontal Amplifier Block Diagram

4-7. CALIBRATOR.

The calibrator signal is generated by a plate-coupled multivibrator, V306. (See schematic diagram figure 6-17.) A clamp diode, V307A, limits the positive output of the multivibrator to +110 volts. A disconnect diode, V307B, disconnects the multivibrator from the output when the multivibrator signal goes below zero volts. The output signal, then, is a square wave which varies between zero and +110 volts. The square wave is applied to a step attenuator and then to the VOLTS terminal of the calibrator output on the front panel. A second, fixed attenuator reduces the VOLTS signal 1000:1 and connects the smaller signal to the MV terminal of the calibrator output. The CALIBRATOR switch controls the step annenuator and selects the calibrator output in volts and millivolts.

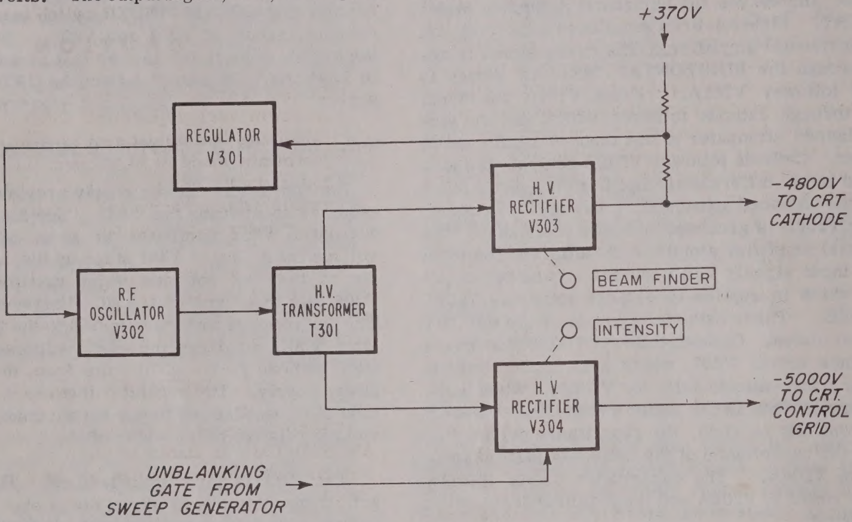

+370V
REGULATOR V301
H. V. RECTIFIER V303
-4800V TO CRT CATHODE
R.F. OSCILLATOR V302
H.V. TRANSFORMER T301
BEAM FINDER
INTENSITY
H. V. RECTIFIER V304
-5000V TO CRT CONTROL GRID
UNBLANKING GATE FROM SWEEP GENERATOR

Figure 4-7 High Voltage Power Supply Block Diagram

4-8. LOW VOLTAGE POWER SUPPLIES.

The low voltage power supplies include an independent supply and three dependent supplies. The -100 volt supply is the independent supply. It is a reference for the +370 and +110 volt supplies and provides operating voltage to the differential amplifier of the +110 volt supply and to the comparison amplifier of the ±6.3 volt supply.

A simplified block diagram of a regulated power supply is shown in figure 4-8. The series regulator acts as a variable resistance in series with the supply output (even if the series regulator is in the return leg of the supply, the regulator is in series with the output). A comparison or differential amplifier senses any change in the output voltage by comparing the output against a reference voltage. The amplifier then changes the effective resistance of the series regulator, and thereby the voltage drop across it, to oppose the change in output voltage. The low voltage power supplies are transistorized, and except in the +370 volt supply, one or more emitter followers are required between the amplifier and series regulator to build up the current to the level required to drive the series regulator.

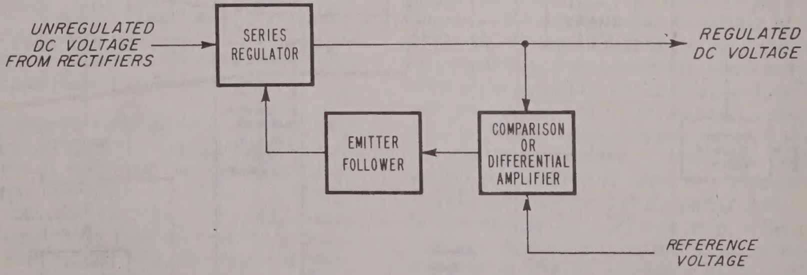

UNREGULATED DC VOLTAGE FROM RECTIFIERS
SERIES REGULATOR
REGULATED DC VOLTAGE
EMITTER FOLLOWER
COMPARISON OR DIFFERENTIAL AMPLIFIER
REFERENCE VOLTAGE

Figure 4-8 Regulated Power Supply, Simplified Block Diagram

SECTION 5

TROUBLE-SHOOTING

5-1. INTRODUCTION.

This section contains trouble-shooting information and tests for locating and correcting most of the troubles which may develop in Oscilloscope AN/USM-105A. The trouble-shooting procedures in this section first isolate a malfunction to a major section of the instrument--vertical amplifier, horizontal amplifier. etc.--and then localize the malfunction to a particular stage or component within the section. This manual cannot describe all possible troubles which may arise. If a specific trouble, test, and remedy are not covered, proceed with standard signal tracing technique. All tests and procedures outlined in NAVSHIP 91828(A), Handbook of Test Methods and Practices, are generally applicable for trouble-shooting this instrument.

Two principal methods of trouble-shooting are used in this manual. First, front-panel indications are observed and compared to normal indications for the given conditions. Second, voltage and resistance measurements are made and compared with normal values as given on the schematic diagrams, figure 6-10 to 6-19, and voltage resistance diagrams. The first method is intended primarily to isolate a malfunction to a major section of the instrument. The breakdown of these sections is shown in figure 5-1. The second method is intended for locating the particular stage and component within a section.

CAUTION

Do not change the setting of any internal (screwdriver) adjustment without first determining that adjustment is required. Adjustments made in an attempt to compensate for a faulty component can complicate the repair problem and may necessitate complete instrument recalibration.

A thorough understanding of the circuits in this instrument is a valuable aid in trouble-shooting. Study section 4, Principles of Operation, before starting with the trouble-shooting or repair procedures.

5-2. TEST EQUIPMENT AND SPECIAL TOOLS.

Test equipment for trouble-shooting Oscilloscope AN/USM-105A is listed in table 5-1. Equipment of similar characteristics can be substituted for those listed.

5-3. OVERALL TROUBLE SHOOTING.

a. PRELIMINARY CHECK. - The preliminary

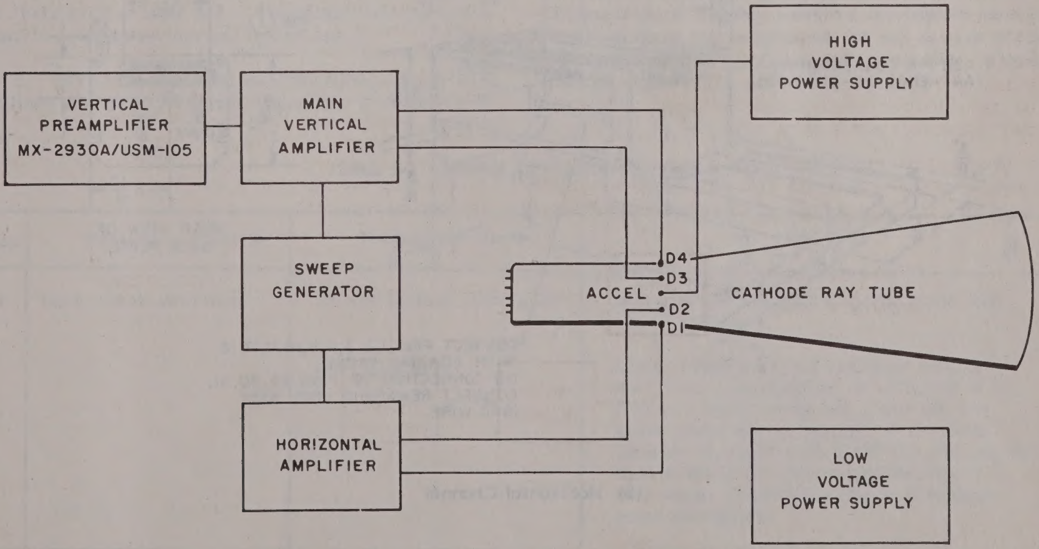
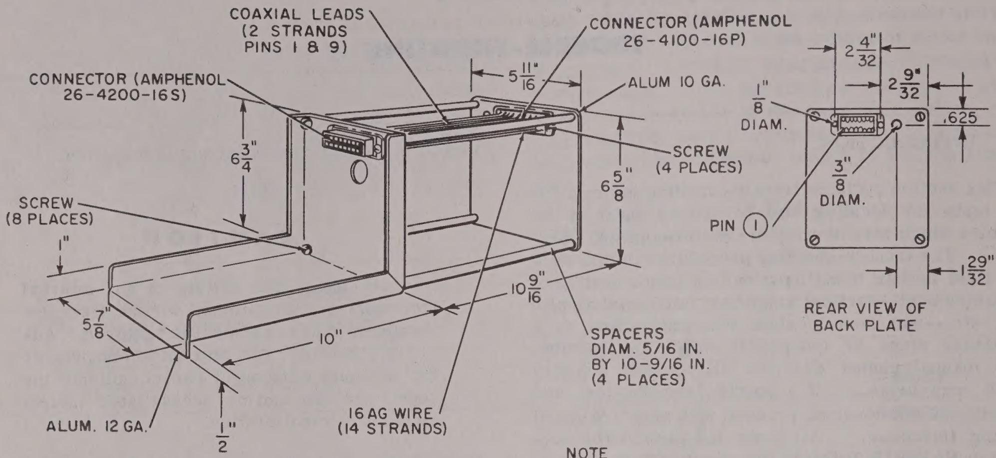


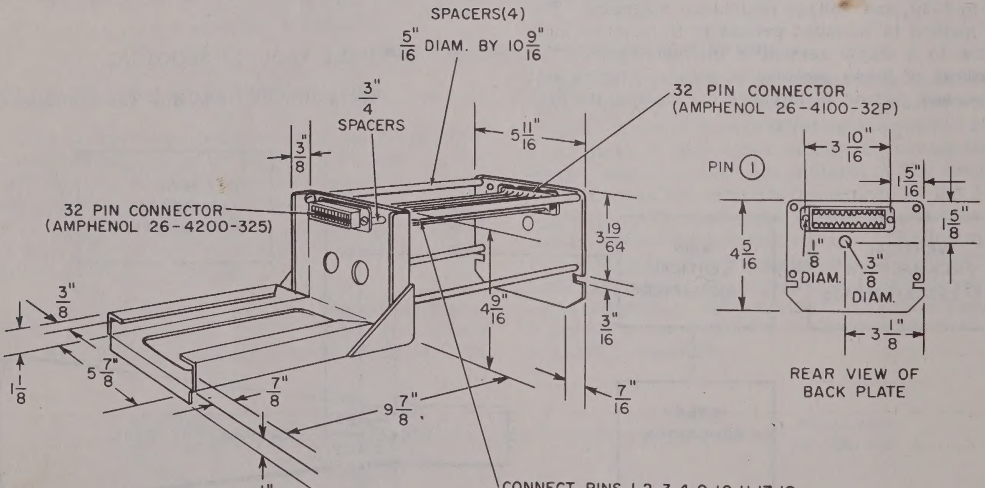
Figure 5-1 Functional Block Diagram


COAXIAL LEADS (2 STRANDS PINS 1 & 9)
CONNECTOR (AMPHENOL 26-4100-16P)
CONNECTOR (AMPHENOL 26-4200-16S)
5 11/16"
ALUM 10 GA.
6 3/4"
SCREW (4 PLACES)
6 5/8"
SCREW (8 PLACES)
1"
5 7/8"
10 9/16"
10"
SPACERS DIAM. 5/16 IN. BY 10-9/16 IN. (4 PLACES)
ALUM. 12 GA.
1/2"
16 AG WIRE (14 STRANDS)
2 4/32"
2 9/32"
1/8" DIAM.
.625
3/8" DIAM.
PIN ①
1 29/32"
REAR VIEW OF BACK PLATE

NOTE

SOLDER WIRE STRANDS TO IDENTICALLY NUMBERED PIN ON CONNECTORS

(a) Vertical Channel


SPACERS(4) 5/16" DIAM. BY 10 9/16"
3/4" SPACERS
3/8"
32 PIN CONNECTOR (AMPHENOL 26-4100-32P)
5 11/16"
32 PIN CONNECTOR (AMPHENOL 26-4200-325)
3 19/64
4 9/16"
3/16"
3/8"
5 7/8"
1 1/8
7/8"
9 7/8"
7/16"
1/2"
PIN ①
3 10/16"
1 5/16"
1 5/8"
4 5/16
1/8" DIAM.
3/8" DIAM.
3 1/8"
REAR VIEW OF BACK PLATE

CONNECT PINS 1,2,3,4,9,10,11,17,18 WITH COAXIAL CABLE; NO CONNECTION TO PINS 25,30,31; CONNECT REMAINING PINS WITH 16AG WIRE.

(b) Horizontal Channel

Figure 5-2 Special Plug-in Extenders

TABLE 5-1 TEST EQUIPMENT AND SPECIAL TOOLS

Item	Function	Description	Number
1	Testing tubes for dynamic and static characteristics	Tube tester	AN/USM-118A
2	Voltage and resistance measurements; high voltage measurements.	Electronic Multimeter with high voltage probe.	AN/USM-116
3	Precise voltage measurements.	Electronic Multimeter	Fluke 801 or Fluke 803
4	AC voltage measurements.	Electronic AC Voltmeter	Hewlett-Packard 400H
5	Operation of dual trace preamplifier outside oscilloscope.	Special Extender	To be constructed at test station (see Figure 5-2A)
6	Operation of Auxiliary Plug-In outside oscilloscope.	Special Extender	To be constructed at test station (see Figure 5-2B)

check consists of visually checking for such items as a dirty filter, broken or loose control knobs, damaged CRT and graticule, damaged input connectors, and soot on louvers (indicating internal fire). Following the preliminary check, proceed to system trouble-shooting, outlined in table 5-2.

b. TEST EQUIPMENT AND SPECIAL TOOLS. - No test equipment or special tools are required for system trouble-shooting as outlined in table 5-2.

c. CONTROL SETTINGS. - For system trouble-shooting, connect the instrument to a 115 volt. 47.5-440 cycle power source. Set the controls and switches as instructed in table 5-2. Paragraph 3-4 describes control settings for normal operations.

d. SYSTEM TROUBLE-SHOOTING. - Table 5-2 outlines the steps required to isolate a trouble to a particular section. When a faulty section is located, visually check the section for obvious troubles. In many cases, instrument failure is due to a defective electron tube which often can be detected visually with the instrument on. The instrument can then be returned to service by replacing the defective tube and checking the calibration of the particular circuit repaired. Table 3-1 lists adjustments required following replacement of tubes and transistors. If the trouble in the faulty section is not obvious, proceed to the paragraph below which describes trouble-shooting for the particular section.

System trouble-shooting can be done with the instrument in its cabinet; however, the cabinet must be removed from the instrument for any section except the dual trace preamplifier and the auxiliary plug-in unit to be accessible.

TABLE 5-2 SYSTEM TROUBLE-SHOOTING

Step	Preliminary Action	Normal Function	Next Step
1	Turn power switch on.	Power on indicator lights	If not, check line fuses, power cable, and power switch.
		Fan operates.	If not, check overheat indicator behind dual trace preamplifier. If indicator is on, thermal relay has turned power off; remove cause of overheating. If overheat light is off, check fuse F406 (6.3 volt supply) behind dual trace pre-amplifier, then 6.3 volt supply if fuse all right or if replacement fuse blows.

TABLE 5-2. SYSTEM TROUBLE-SHOOTING

Step	Preliminary Action	Normal Function	Next Step
2	Set HORIZONTAL DISPLAY to XI, SWEEP TIME to 50 MILLISECONDS/CM, SWEEP MODE to FREE RUN, and center vertical and horizontal position controls.	Sweep appears on CRT; SWEEP ARMED light flashes periodically.	If SWEEP ARMED light stays on or off, check sweep generator. If only a spot appears, check horizontal amplifier. If spot or sweep appears only with BEAM FINDER pressed, note whether offset is vertical or horizontal. If horizontal, check horizontal amplifier; if vertical, see step 5. If sweep appears only with BEAM FINDER pressed and INTENSITY set almost fully clockwise, check V107 circuit in sweep generator. If nothing appears with BEAM FINDER pressed and INTENSITY set fully clockwise, check low voltage power supplies, final stages of vertical and horizontal amplifiers, high voltage power supply, and CRT in that order.
3	Set Vertical Presentation to CHANNEL A, SENSITIVITY to .02, CALIBRATOR to 100, SWEEP TIME to .5 MILLISECONDS/CM, TRIGGER SOURCE to INT. Connect mv calibrator output to Channel A INPUT. Set SWEEP MODE to FREE RUN then to PRESET. Repeat for Channel B.	Square wave appears on CRT on both free-running and preset sweeps.	If function normal, proceed to step 4. If only one channel of dual trace preamplifier functions normally, check faulty channel. If little or no deflection from either channel of dual trace preamplifier, check main vertical amplifier, dual trace preamplifier, calibrator. If presentation unstable or present only with SWEEP MODE set to FREE RUN, check trigger circuits (V3, V101 and V103). If sweep appears far out of calibration, check sweep calibration, then calibrator frequency. If both vertical and sweep appear far out of calibration, check +370 volt supply, then high voltage supply.
4	Leave control settings and connections as in step 3 above except set Vertical Presentation to CHOPPED then to ALTERNATE.	Dual channel presentation on CRT; square wave from one channel, no signal (sweep only) from other channel.	If function normal on steps 3 and 4, major circuits are operating. Rotate switches and controls to check all possibilities. If dual channel presentation on CHOPPED only, check V507 in dual trace preamplifier.
5	Disconnect dual trace preamplifier by sliding it partially out of oscilloscope.	Sweep is approximately centered vertically.	If sweep approximately centered, check dual trace preamplifier. If sweep remains vertically offset, check main vertical amplifier.

5-4. FUNCTIONAL TROUBLE-SHOOTING.

a. INTRODUCTION. - The test described in the following tables are provided to isolate troubles to a particular stage or component within a section of the instrument. If trouble occurs in more than one section trouble-shoot and repair the sections in the same sequence as the procedures are given below.

WARNING

Turn instrument off before following any instruction (calling for disconnection of leads, removal of tubes, etc.) which might cause contact with off-ground potentials.

b. PRELIMINARY CHECK. - The following preliminary procedures generally apply to functional section trouble-shooting.

(1) Visually inspect the section at fault. Look for such items as charred resistors, dark spots on etched circuit boards which might indicate flashover or breakdown, cracks in circuit boards, and unlighted tubes.

(2) Check the seating of all tubes in their sockets.

(3) Inspect loose connections on components, loose ground lugs, and corrosion on any ground lug or component connections.

c. TEST EQUIPMENT AND SPECIAL TOOLS. - The test equipment and special tools required for functional section trouble-shooting are listed in table 5-1. However, item 6, horizontal plug-in extender, may not be needed unless an horizontal plug-in unit other than the auxiliary plug-in is used.

d. LOW VOLTAGE POWER SUPPLIES. - Table 5-3 describes procedures for trouble-shooting the low voltage power supplies. Breakdown diodes CR413 and CR416 can be checked by measuring the voltage across them. However, if the supply voltage is so low that breakdown cannot occur, the diodes must be removed and checked with a constant current power supply.

Unless instructed otherwise, check the power supplies with the instrument turned on. The settings of the other controls have no effect.

Note

When performing the following tests, reconnect leads before proceeding to next step unless directed to do otherwise.

Use a precision voltmeter (item 3, table 5-1) for dc voltage measurements in the low voltage power supply.

TABLE 5-3 LOW VOLTAGE POWER SUPPLY TROUBLE-SHOOTING

Step	Test Point	Preliminary Action	Normal Indication	Next Step
1	D_1 thru D_5 Fig. 5-3 and 6-17	Measure dc voltages and ripple at test point D_1 thru D_5, with line voltage at 115 volt, 103 volt, and 127 volt.	Voltages should be as indicated on schematic diagram Figure 6-18	If a supply output is incorrect, see procedure for that supply below. If a supply has poor dc regulation, check its amplifier, then series regulator. If a supply has excessive ripple, check its filter capacitors.
			6.3 VOLT SUPPLY	
2	D_1 thru D_2 Fig. 5-3 and 6-17	Check fuse F406 and replace it if it is faulty.	Voltages at test points D_1 and D_2 return to normal.	If replacement fuse blows, check fan motor B401 and check for short between +6.3 and -6.3 volt busses. If voltage between D_1 and D_2 is approximately 12 volts but not balanced to ground, check for low resistance to ground from test point with voltage closer to zero.

TABLE 5-3. LOW VOLTAGE POWER SUPPLY TROUBLE SHOOTING (Cont'd)

Step	Test Point	Preliminary Action	Normal Indication	Next Step
				If voltage between test points D_1 and D_2 is significantly different from 12.6 volts but is approximately balanced to ground, see step 3.
3		Measure voltage across C425.	About 18 volts (with line voltage at 115 v)	If wrong, check CR414, CR415, and L406. If voltage across C425 correct but voltage between test points D_1 and D_2 high, see step 7. If voltage across C425 correct but voltage between test points D_1 and D_2 low, see step 4.
4		Disconnect collector of Q414.	Voltage between test points D_1 and D_2 increases.	If supply output goes high, check CR416 and Q414. If not, proceed to step 5.
5		Short emitter to collector of Q415.	Voltage between test points D_1 and D_2 increases.	If supply output goes high, check Q415. If not, proceed to step 6.
6		Short emitter to collector of Q416.	Voltage between test points D_1 and D_2 increases.	If supply output goes high, check Q416. If not, check Q417.
7		Disconnect base of Q417.	Voltage between test points D_1 and D_2 decreases.	If no appreciable change in supply output, check Q417. If voltage drops, proceed to step 8.
8		Disconnect base of Q416.	Voltage between test point D_1 and D_2 decreases.	If no appreciable change in supply output, check Q416. If voltage drops, proceed to step 9.
9		Disconnect base of Q415	Voltage between test points D_1 and D_2 decreases.	If no appreciable change in supply output, check Q415. If voltage drops, check CR416 and Q414.
		-100 VOLT SUPPLY		
10	ⓓ D_3 Fig. 5-3 and 6-17	Check fuse F405 and replace it if it is faulty.	Voltage at test point D_3 returns to normal.	If replacement fuse blows, see step 11. If voltage at test point D_3 is wrong, see step 13.
11		Turn instrument off. Disconnect vio/orn leads from test point D_3 and sweep generator circuit board A101. Measure resistance to ground from test point D_3 and from vio/orn lead removed from test point D_3.	Resistance from test point D_3 to ground should be about 13K. Resistance from vio/orn lead to ground should be about 2K.	If resistance from D_3 to ground is low, check for short external to power supply. If resistance from vio/orn lead to ground low, check for short within power supply. If both resistances normal, proceed to step 12.

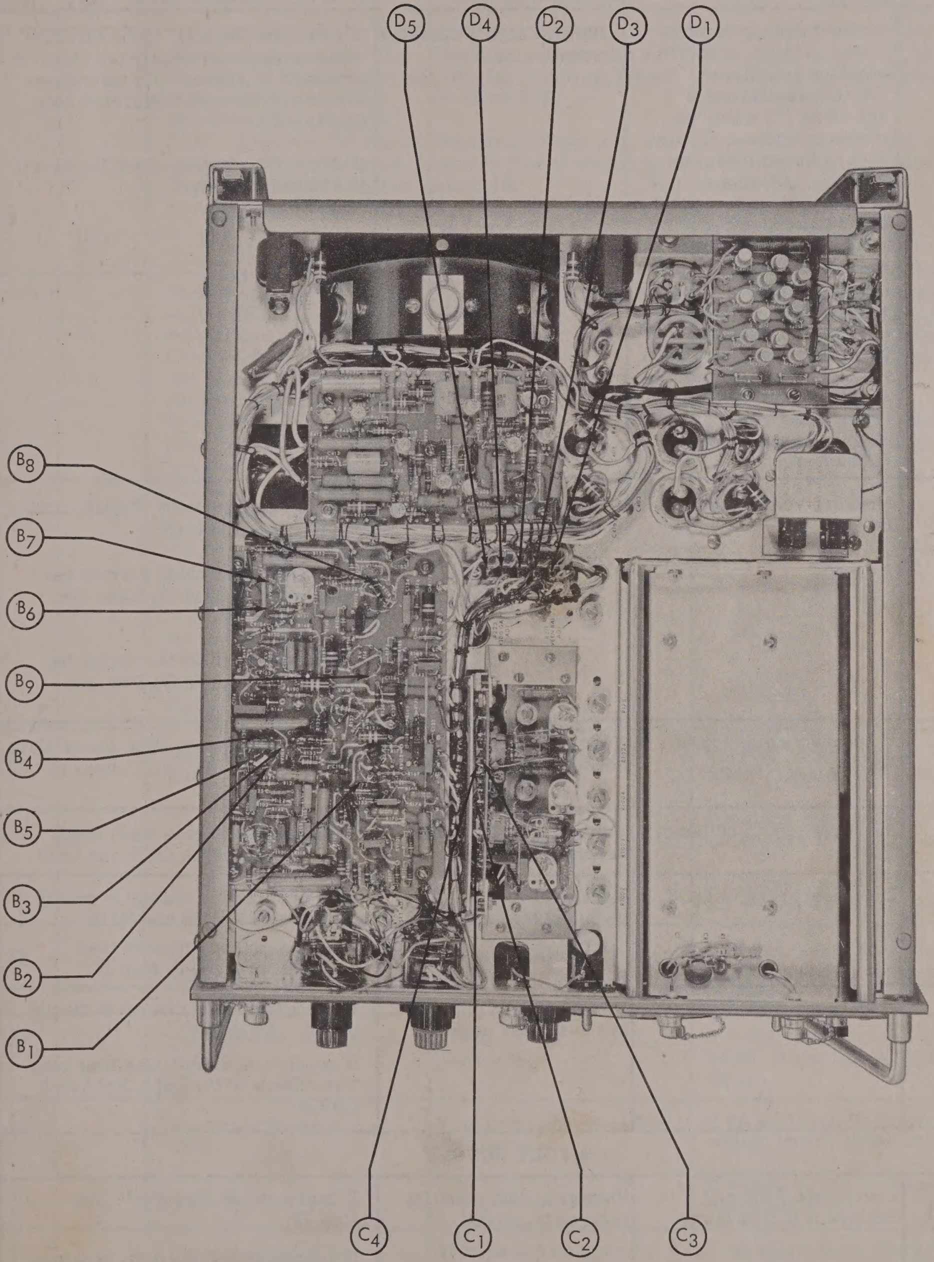

D_5
D_4
D_2
D_3
D_1
B_8
B_7
B_6
B_9
B_4
B_5
B_3
B_2
B_1
C_4
C_1
C_2
C_3

Figure 5-3 Location of Test Points on Bottom Deck

TABLE 5-3. LOW VOLTAGE POWER SUPPLY TROUBLE SHOOTING (Cont'd)

Step	Test Point	Preliminary Action	Normal Indication	Next Step
12		Connect dummy loads to -100 v, +110 v, and +370 v supplies as follows: Connect resistance of 165 ohms (75 watts) between ground and vio/orn lead removed from test point D_3. Disconnect pnk/orn leads from test point D_4 and sweep generator circuit board A101; connect resistance of 125 ohms (150 watts) between ground and pnk/orn lead removed from test point D_4. Disconnect red/orn lead from test point D_5; connect resistance of 1160 ohms (150 watts) between ground and red/orn lead. Turn instrument on.	-100 volt supply operates normally.	If indication normal, check circuits external to power supply for short not likely to appear with instrument turned off (tube with interelectrode short, etc.). If F405 again blows, check for short in -100 volt supply.
13		Measure voltage across C416.	About 145 v (with line voltage at 115 v)	If wrong, check CR409, CR410, CR411, CR412, L404 and C416. If voltage across C416 correct but voltage at test point D_3 high, see step 16. If voltage across C416 correct but voltage at test point D_3 low, see step 14.
14		Disconnect collector of Q411	Voltage at test point D_3 becomes more negative.	If supply output goes high, check Q411, Q410 and V401. If not, proceed to step 15.
15		Short emitter to collector Q412	Voltage at test point D_3 becomes more negative.	If supply output goes high, check Q412. If not, check Q413 and Q419.
16		Disconnect base of Q413	Voltage at test point D_3 becomes less negative.	If no appreciable change in supply output, check Q413 and Q419. If supply output becomes less negative, proceed to step 17.
17		Disconnect base of Q412.	Voltage at test point D_3 becomes less negative.	If not appreciable change in supply output, check Q412. If supply output becomes less negative, check Q410, Q411, V401 and CR413.
+110 VOLT SUPPLY				
18	(D_4) Fig. 5-3 and 6-17	Check fuse F404 and replace it if it is faulty.	Voltage at test point D4 returns to normal.	If replacement fuse blows, see step 19. If voltage at test point D_4 is wrong, see step 21.

TABLE 5-3. LOW VOLTAGE POWER SUPPLY TROUBLE SHOOTING (Cont'd)

Step	Test Point	Preliminary Action	Normal Indication	Next Step
19		Turn instrument off. Disconnect pnk/orn leads from test point D_4 and sweep generator circuit board A101. Measure resistance to ground from test point D_4 and from pnk/orn lead removed from D_4.	Resistance from test point D_4 to ground should be about 55K. Resistance from pnk/orn lead to ground should be about 3K.	If resistance from D_4 to ground is low, check for short external to power supply. If resistance from pnk/orn lead to ground is low, check for short within power supply. If both resistances normal, see step 20.
20		Connect dummy loads to +110 v, -100 v, and +370 v supplies as follows: Connect resistance of 125 ohms (150 watts) between ground and pnk/orn lead removed from test point D_4. Disconnect vio/orn leads from test point D_3 and sweep generator circuit board A101; connect resistance of 165 ohms (75 watts) between ground and vio/orn lead removed from D_3. Disconnect red/orn lead from test point D_5; connect resistance of 1160 ohms (150 watts) between ground and red/orn lead. Turn instrument on.	+110 volt supply operates normally.	If indication normal, check circuits external to power supply for short not likely to appear with instrument turned off (tube with interelectrode short, etc.). If F404 blows again, check for short within power supply.
21		Measure voltage across C408.	About 160 v (with line voltage at 115 v).	If wrong, check CR405, CR406, CR407, CR408, L402 and C408. If voltage across C408 correct but voltage at D_4 high, see step 24. If voltage across C408 correct but voltage at D_4 low, see step 22.
22		Disconnect collector of Q407	Voltage at test point D_4 increases.	If supply output goes high, check Q406 and Q407. If not, proceed to step 23.
23		Short emitter to collector of Q408	Voltage at test point D_4 increases.	If supply output goes high, check Q408. If not, check Q409 and Q418.
24		Disconnect base of Q409.	Voltage at test point D_4 decreases.	If no appreciable change in supply output, check Q409 and Q418. If supply output decreases, proceed to step 25.
25		Disconnect base of Q408.	Voltage at test point D_4 decreases.	If no appreciable change in supply output, check Q408. If supply output decreases, check Q406 and Q407.

TABLE 5-3. VOLTAGE POWER SUPPLY TROUBLE SHOOTING (Cont'd)

Step	Test Point	Preliminary Action	Normal Indication	Next Step
			+370 VOLT SUPPLY	
26	D_5 Fig. 5-3 and 6-17	Check fuse F403 and replace it if it is faulty.	Voltage at test point D_5 returns to normal.	If replacement fuse blows, see step 27. If voltage at test point D_5 is wrong, see step 29.
27		Turn instrument off. Disconnect red/orn lead from test point D_5. Measure resistance to ground from test point D_5 and from red/orn lead removed from D_5.	Resistance from test point D_5 to ground should be about 17K. Resistance from red/orn lead to ground should be about 13K.	If resistance from D_5 to ground is low, check for short external to power supply. If resistance from red/orn lead to ground is low, check for short within power supply. If both resistances normal, see step 28.
28		Connect dummy loads to +370 v, -100 v, and +110 v supplies as follows: Connect resistance of 1160 ohms (150 watts) between ground and red/orn lead removed from test point D_5. Disconnect vio/orn leads from test point D_3 and a sweep generator circuit board A101; connect resistance of 165 ohms (75 watts) between ground and vio/orn lead removed from test point D_3. Disconnect pnk/orn leads from test point D_4 and sweep generator circuit board A101; connect resistance of 125 ohms (150 watts) between ground and pnk/orn lead removed from test point D_4. Turn instrument on.	+370 volt supply operates normally.	If indication normal, check circuits external to power supply for short not likely to appear with instrument turned off (tube with interelectrode short, etc.). If F403 blows again, check for short within power supply.
29		Measure voltage across C401.	About 350 volts (with line voltage at 115 v).	If wrong, check CR401, CR402, CR403, CR404 and C401. If voltage across C401 correct but voltage at test point C_5 high, see step 31. If voltage across C401 correct but voltage at test point D_5 low, see step 30.
30		Disconnect collector of Q402	Voltage at test point D_5 increases.	If supply output goes high, check Q401 and Q402. If not, check Q403, Q404 and Q405.
31		Disconnect base of Q405	Voltage at test point D_5 decreases.	If no appreciable change in supply output, check Q403, Q404 and Q405. If supply output decreases, check Q401 and Q402.

e. HIGH VOLTAGE POWER SUPPLY. - Table 5-4 describes tests for trouble-shooting the high voltage power supply. Before starting, turn instrument on and set SWEEP MODE control just out of PRESET.

WARNING

High voltages up to 5000 volts are generated in the high voltage power supply. Use extreme caution when performing tests and measurements. Use probes and instruments suited to high voltage measurements. Discharge capacitors with shorting bar.

TABLE 5-4 HIGH VOLTAGE POWER SUPPLY TROUBLE-SHOOTING

Step	Test Point	Preliminary Action	Normal Indication	Next Step
1	F_1 F_2 Fig. 5-4 and 6-16	Measure CRT cathode and grid supply voltages at test points F_1 and F_2.	Test point F_1: -4800 volts. Test point F_2: -5000 volts.	If indications normal, check CRT. If low voltage from only one supply, check rectifier then other components of faulty supply. If voltage low from both supplies, proceed to step 2. If voltage from both supplies high, check regulator V301.
2		Observe waveform at pin 5 (plate) of rf oscillator V302.	50 kc sine wave, approximately.	If indication normal, check rectifiers then other components of both supplies. If oscillator not oscillating, see step 3.
3		Remove rectifiers and recheck waveform at pin 5 of V302.	50 kc sine wave, approximately.	If indication normal, see step 4. If indication not normal, check V302 then other components of oscillator circuit.
4		Replace rectifiers one at a time and recheck waveform at pin 5 of V302.	50 kc sine wave, approximately.	Note which supply kills oscillations. Check components including transformer T301 for that supply.

f. HORIZONTAL AMPLIFIER. - Table 5-5 describes test for isolating trouble in the horizontal amplifier to a single stage. Locate defective components within the stage by making detailed voltage and resistance measurements in the stage. Before starting, set front-panel controls as follows:

(1) Power switch to ON.
(2) HORIZONTAL DISPLAY to 10 VOLTS/CM.
(3) Center HORIZONTAL POSITION control.

TABLE 5-5 HORIZONTAL AMPLIFIER TROUBLE-SHOOTING

Step	Test Point	Preliminary Action	Normal Indication	Next Step
1	C_5 thru C_{10} Fig. 5-3, 5-4 and 6-15	Check voltage successively at C_1 through C_{12}.	Voltages should be approximately as indicated on schematic diagram.	Check first state having incorrect voltages. If incorrect voltages appear at C_5 through C_{10}, disconnect feedback (R246 and R260); voltages may change some, but amplifier should remain balanced.

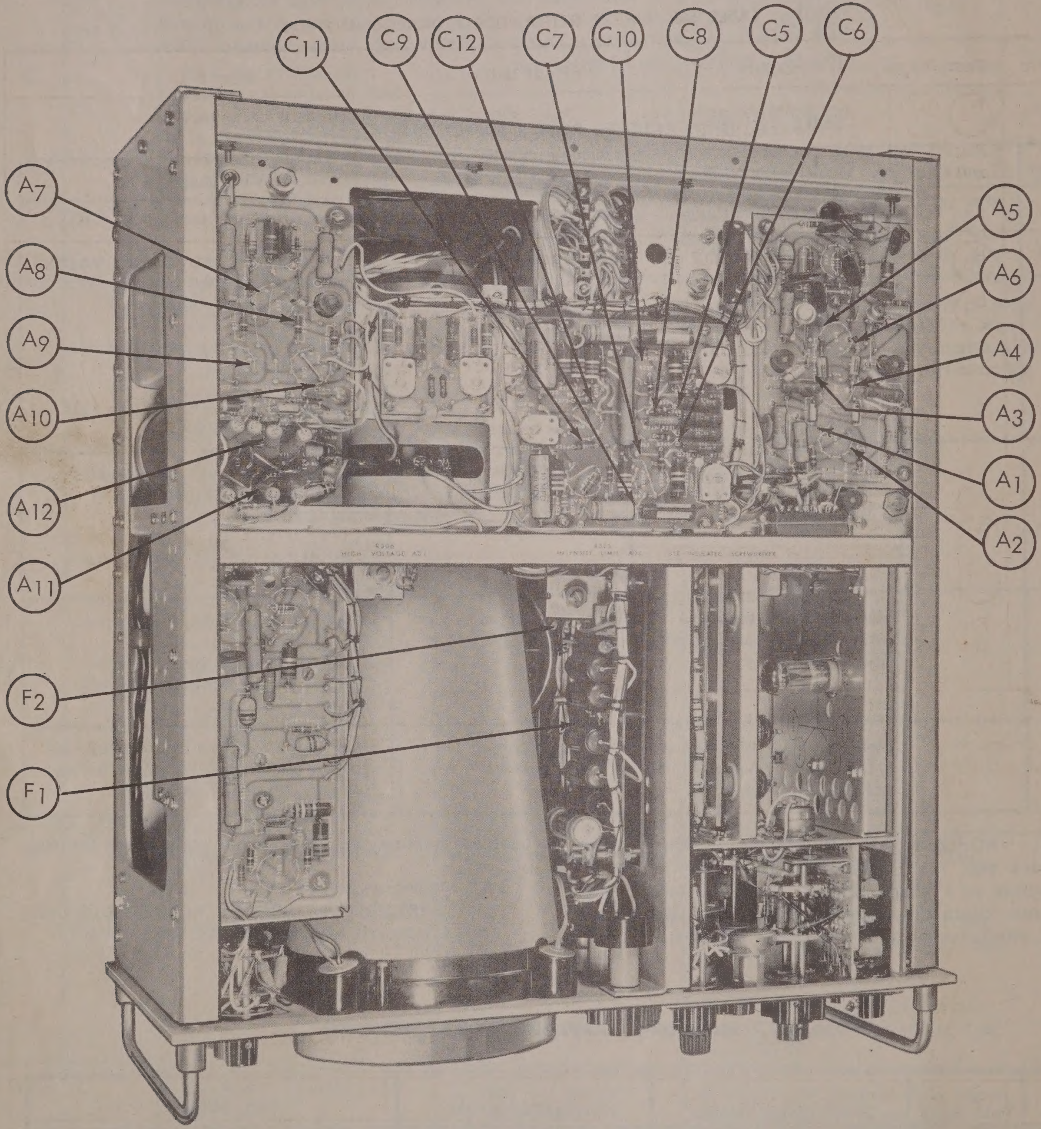

C11
C9
C12
C7
C10
C8
C5
C6
A7
A8
A9
A10
A12
A11
A5
A6
A4
A3
A1
A2
F2
F1
HIGH VOLTAGE ADJ
INTENSITY LIMIT ADJ
USE INSULATED SCREWDRIVER

Figure 5-4. Location of Test Points on Top Deck

g. SWEEP GENERATOR. - Table 5-6 describes test for isolating trouble in the sweep generator to a single stage. Locate defective components within the stage by making detailed voltage and resistance measurements in the stage. See figure 5-7.

Before starting, set front-panel controls as follows:

(1) Power switch to ON.
(2) HORIZONTAL DISPLAY to VOLT/CM.
(3) SWEEP TIME to 1 SECOND/CM.

TABLE 5-6 SWEEP GENERATOR TROUBLE-SHOOTING

Step	Test Point	Preliminary Action	Normal Indication	Next Step
1	B_1 B_2 Fig. 5-3 and 6-13	Check voltages at B_1 and B_2 while rotating SWEEP MODE control.	Voltages should vary approximately between values shown.	If indication normal, see step 2. If voltages too negative, check circuit of V113. If voltages too positive, see step 3.
2	B_3 thru B_9 Fig. 5-3 and 6-13	Set SWEEP MODE to FREE RUN, HORIZONTAL DISPLAY to XI. Check voltages successively at test points B_3 through B_9.	Voltages at B_3, B_4, and B_5 should be at second value shown. Other voltages should be varying from first value toward second value as sweep progresses. Since sweep is inoperative, voltages normally will have progressed beyond value indicated on schematic.	Check first circuit giving incorrect indication.
3	B_3 thru B_9 Fig. 5-3 and 6-13	Set SWEEP TIME to 50 MILLISECONDS/CM or faster and SWEEP MODE just out of PRESET. Check voltages successively at test points B_3 through B_9.	Voltages should be at first value shown.	Check first circuit causing incorrect indication.

h. MAIN VERTICAL AMPLIFIER. - Table 5-7 describes tests for isolating trouble in the main vertical amplifier to a single stage. Locate defective components within the stage by making detailed voltage and resistance measurement in the stage. Before starting, turn the instrument on.

Note

Trouble-shoot the main vertical amplifier with the dualtrace preamplifier removed.

TABLE 5-7 MAIN VERTICAL AMPLIFIER TROUBLE-SHOOTING

Step	Test Point	Preliminary Action	Normal Indication	Next Step
1	A_1 thru A_{12} Fig. 5-4 and 6-12	Remove preamplifier and check voltages successively at test points A_1 through A_{12}	Voltages should be as shown on schematic diagram, Figure 6-12	Check first circuit which causes incorrect voltages. If indications normal, check preamplifier.

Step	Test Point	Preliminary Action	Normal Indication	Next Step
2		Set SWEEP TIME to 50 MILLISECONDS/CM or faster and SWEEP MODE to FREE RUN. Adjust intensity control for normal viewing brightness.	Sweep should be approximately centered vertically on CRT graticule.	If indication normal, check preamplifier. If trace is not centered see step 3.
3		Connect a jumber between pin 2 of V8 and Pin 2 of V10	Sweep should be approximately centered vertically on CRT graticule.	If indication normal, see step 4. If trace is not centered check V8, V9, V10, V11, and associated components.
4		Remove jumper from V8 and V10 and connect between pin 8 and 3 or V5.	Sweep should be centered vertically on CRT graticule.	If indication normal, see step 5.
5		Remove jumper from V5 and connect between pin 2 and 7 of V5.	Sweep should be centered vertically on CRT graticule.	If Indication normal, see step 6. If trace is not centered check V5.
6		Remove jumper from V5 and connect between Pin 2 and 7 of V3.	Sweep should be centered vertically on CRT graticule.	If indication normal, see step 7. If sweep is not centered check V3 and associated components.
7		Remove jumper from V3 and connect between pin 2 and 7 of V2	Sweep should be centered vertically on CRT graticule.	If indication normal see step 8. If sweep is not centered check V2 and associated components.
8		Remove jumper from V2 and connect between pin 2 and 7 of V1.	Sweep should be centered vertically on CRT graticule.	If sweep is not centered check V1 and associated components.

i. DUAL TRACE PREAMPLIFIER. - Table 5-8 describes tests for isolating trouble in the dual trace preamplifier to a single stage. Locate defective components within the stage by making detailed voltage and resistance measurements in the stage.

Use the special plug-in extender to operate the preamplifier outside the oscilloscope.

Trouble-shooting results determine front-panel control settings and are given in table 5-8.

TABLE 5-8 DUAL TRACE PREAMPLIFIER TROUBLE-SHOOTING

Step	Test Point	Preliminary Action	Normal Indication	Next Step
1		Use plug-in extender to operate dual trace preamplifier outside oscilloscope.		If one channel inoperative (determined from table 5-2), see step 2. Note: Procedure given for Channel A; procedure and indications similar for Channel B. If both channels inoperative (determined from tables 5-2 and 5-7), see step 3.
2	E_1 thru E_8 Fig. 5-5 and 6-11	Set Vertical Presentation to CHANNEL A and center VERTICAL POSITION control. Check voltages successively at test points E_1 through E_8.	Voltages should be as indicated on schematic diagram, Figure 6-10.	Check first stage causing incorrect indications. If indications normal check input attenuator.
3	E_9 Fig. 6-11	Check voltage at test point E_9 with Vertical Presentation set first to CHANNEL A and then to CHANNEL B.	Voltage should change from first value to second value give on schematic diagram, Figure 6-11.	If indication not normal, check V508 and its circuit. If indication normal, check channels A and B individually, see step 2.

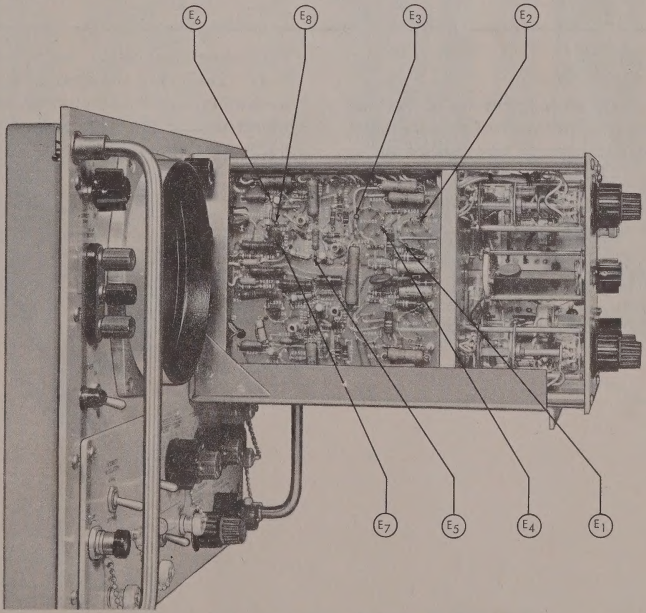


Figure 5-5 Location of Test Points in Dual Trace Preamplifier

5-5. TYPICAL TROUBLES.

Table 5-9 lists some of the less severe troubles which may be encountered. If the nature of the trouble is different from the one listed, refer to paragraph 5-3, Overall Trouble-Shooting.

TABLE 5-9 TYPICAL TROUBLES

Trouble	Nature of Trouble	Symptoms
Power supplies inoperative.	Defective fuse or fuses.	CRT blank even with BEAM FINDER pressed.
No unblanking signal to CRT.	Defective V107.	CRT blank except when BEAM FINDER pressed and INTENSITY set fully clockwise.
No sweep	Defective sweep generator tubes (V104, V105, V109, V113, V114, V115).	SWEEP ARMED indicator stays on or off on slow sweep times with SWEEP MODE set to FREE RUN.
No control of horizontal position.	Defective tubes in horizontal amplifier (V202, V203, V206).	Spot cannot be moved horizontally off screen with HORIZONTAL POSITION control,
No vertical deflection from either channel of dual trace preamplifier.	Defective tubes in main vertical amplifier or dual trace preamplifier. (V1, V2, V3, V5, V508).	Vertical signals do not appear on CRT.
No vertical deflection from one channel of dual trace preamplifier.	Defective tubes in one channel of dual trace preamplifier (V501, V502, V503; or V504, V505, V506).	Operation normal on one channel, no vertical deflection from other channel.
Only single-trace presentation with Vertical Presentation switch set to ALTERNATE.	Defective V507 in dual trace preamplifier.	Dual trace presentation on CHOPPED single-trace only on ALTERNATE.

5-6. LOCATION OF PARTS.

Figures 5-11 through 5-32 show locations of internal assemblies and components not part of an assembly. These assemblies and components are called out by reference designator and cross-referenced in table 7-1. Table 7-1 lists all components included in each assembly, and these components are for the most part identified on the assembly itself by reference designator.

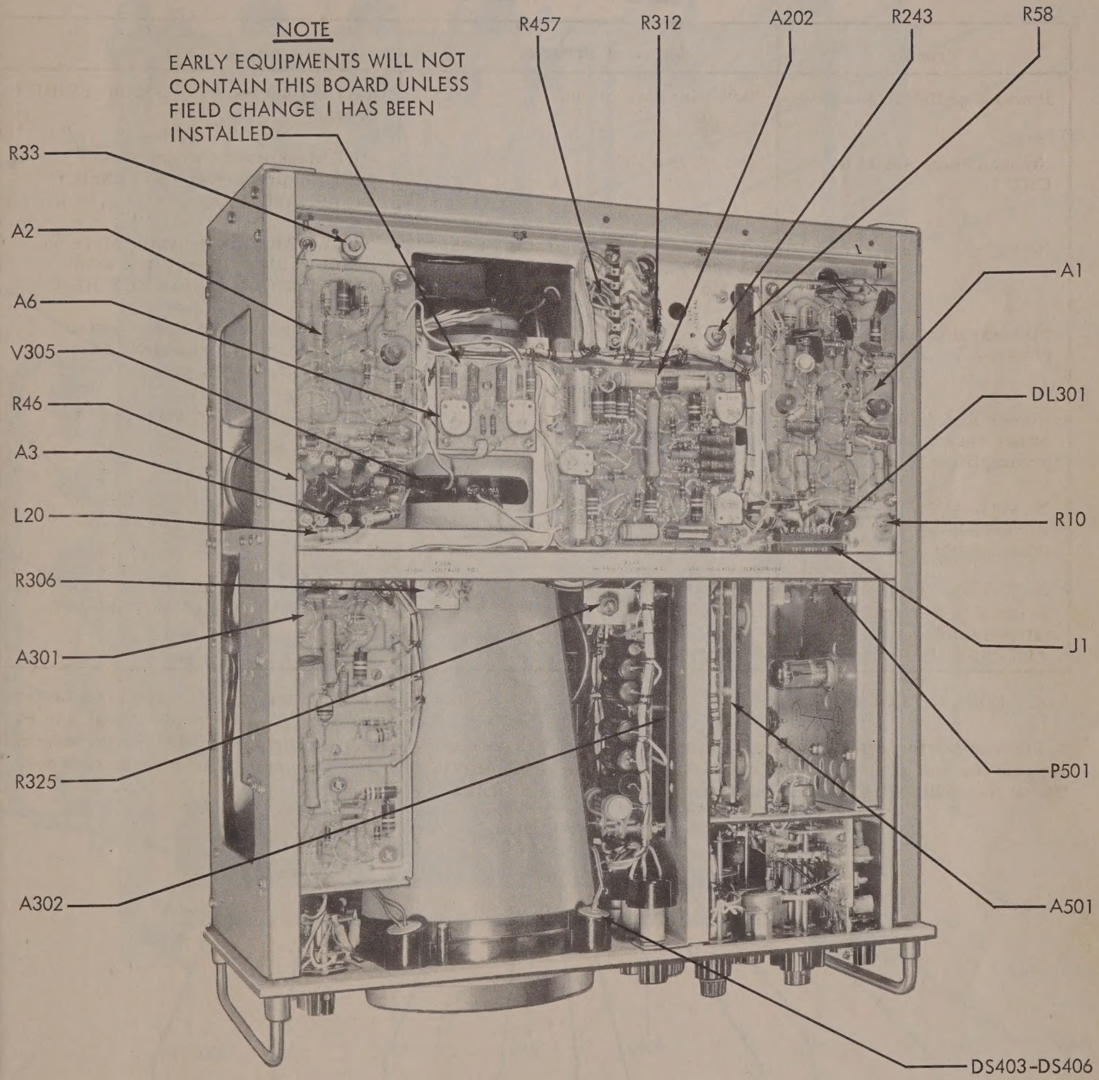

NOTE
EARLY EQUIPMENTS WILL NOT CONTAIN THIS BOARD UNLESS FIELD CHANGE I HAS BEEN INSTALLED
R457
R312
A202
R243
R58
R33
A2
A6
V305
R46
A3
L20
R306
A301
R325
A302
A1
DL301
R10
J1
P501
A501
DS403-DS406

Figure 5-6 Location of Parts on Top Deck

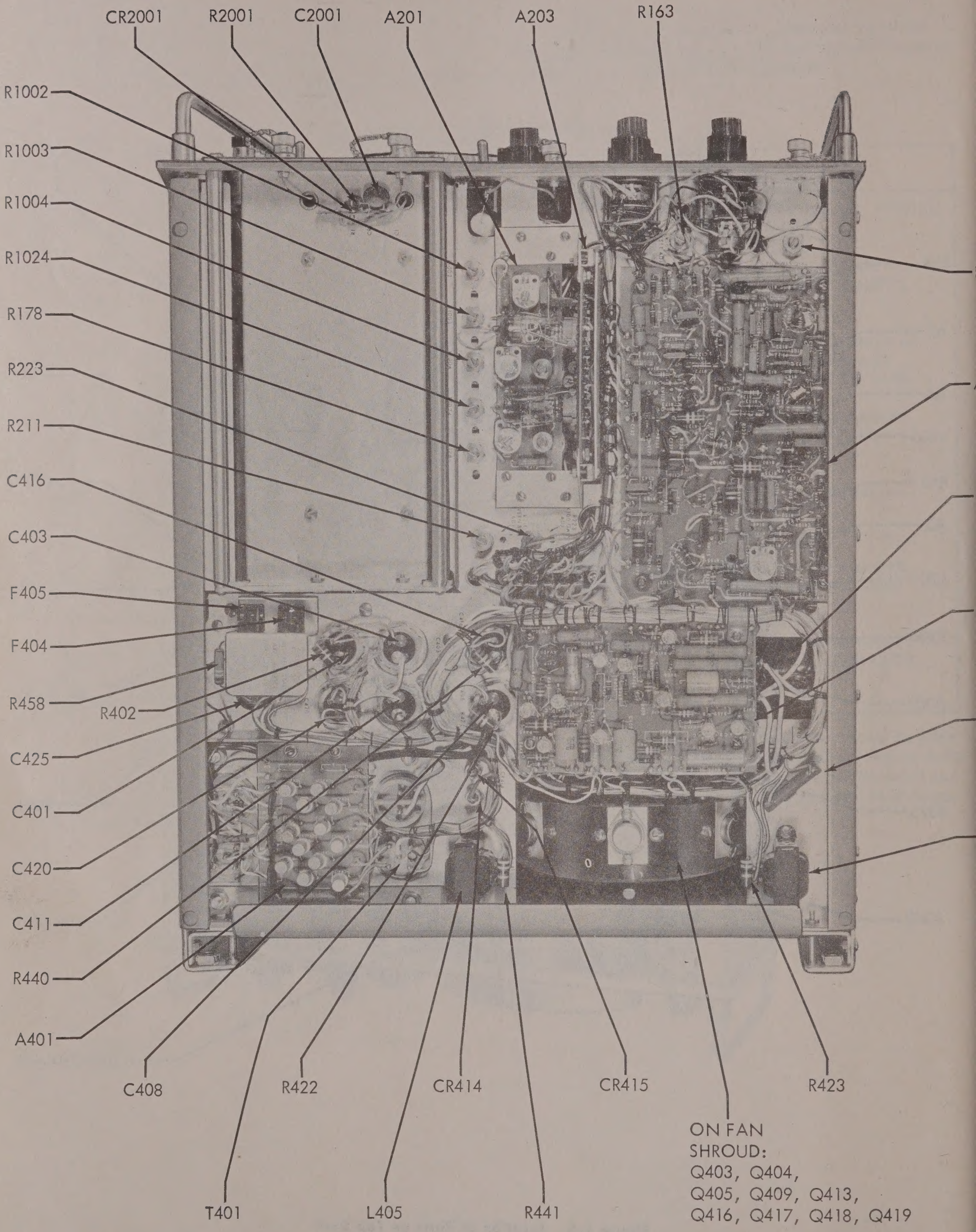

CR2001
R2001
C2001
A201
A203
R163
R1002
R1003
R1004
R1024
R178
R223
R211
C416
C403
F405
F404
R458
R402
C425
C401
C420
C411
R440
A401
C408
R422
CR414
CR415
R423
ON FAN SHROUD:
Q403, Q404,
Q405, Q409, Q413,
Q416, Q417, Q418, Q419
T401
L405
R441

Figure 5-7 Location of Parts on Bottom Deck

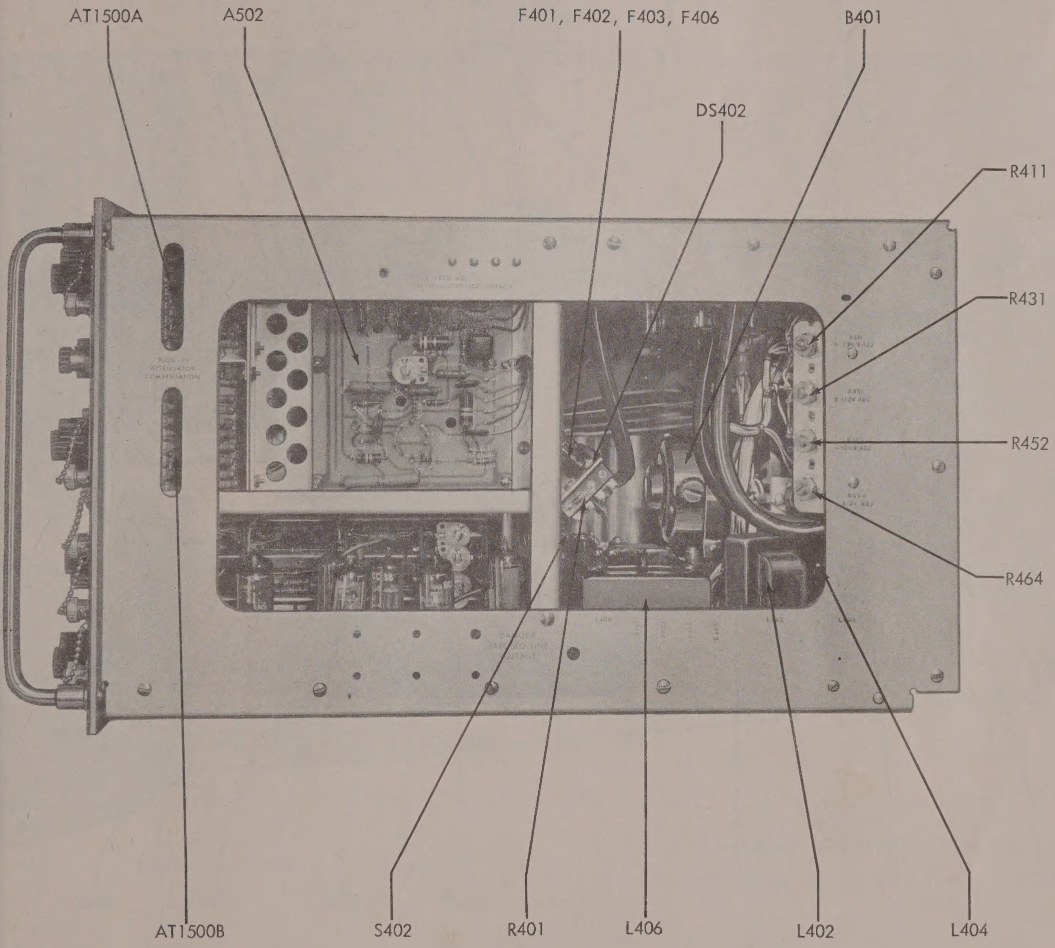

AT1500A
A502
F401, F402, F403, F406
B401
DS402
R411
R431
R452
R464
AT1500B
S402
R401
L406
L402
L404

Figure 5-8 Location of Parts on Right Side

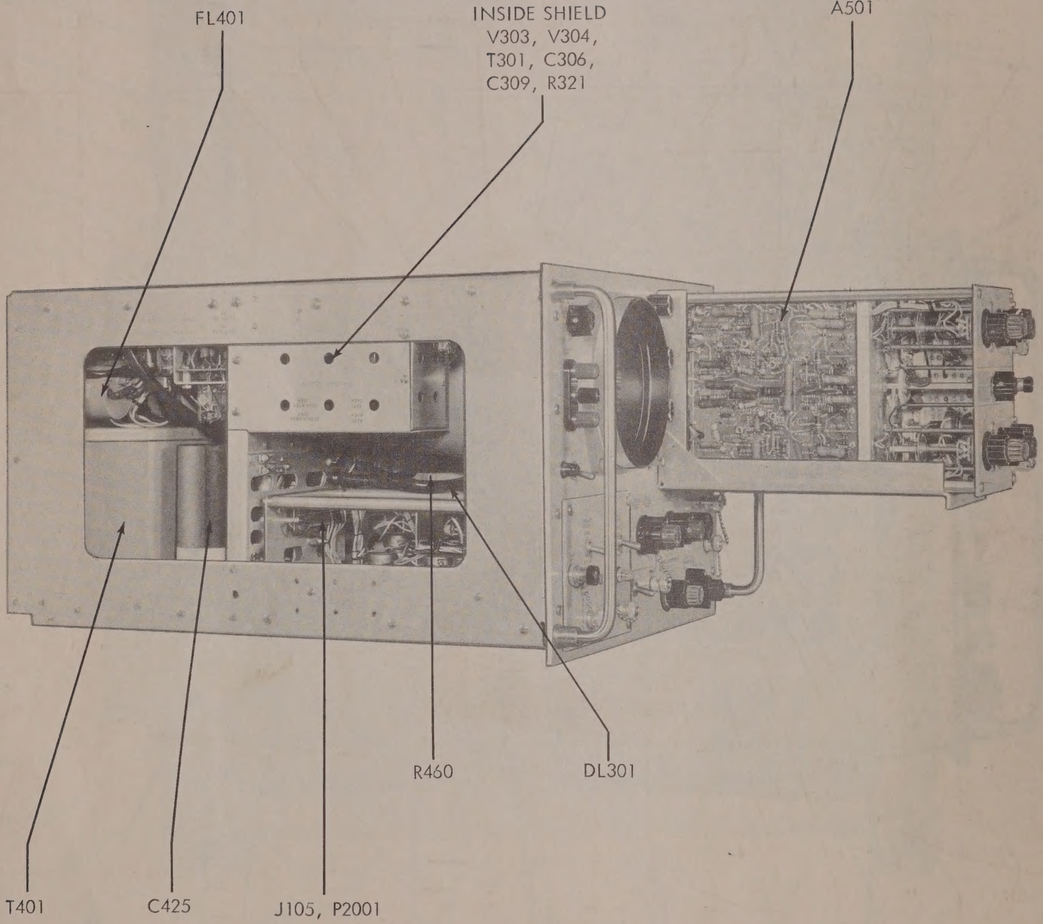

FL401
INSIDE SHIELD
V303, V304,
T301, C306,
C309, R321
A501
R460
DL301
T401
C425
J105, P2001

Figure 5-9 Location of Parts on Left Side

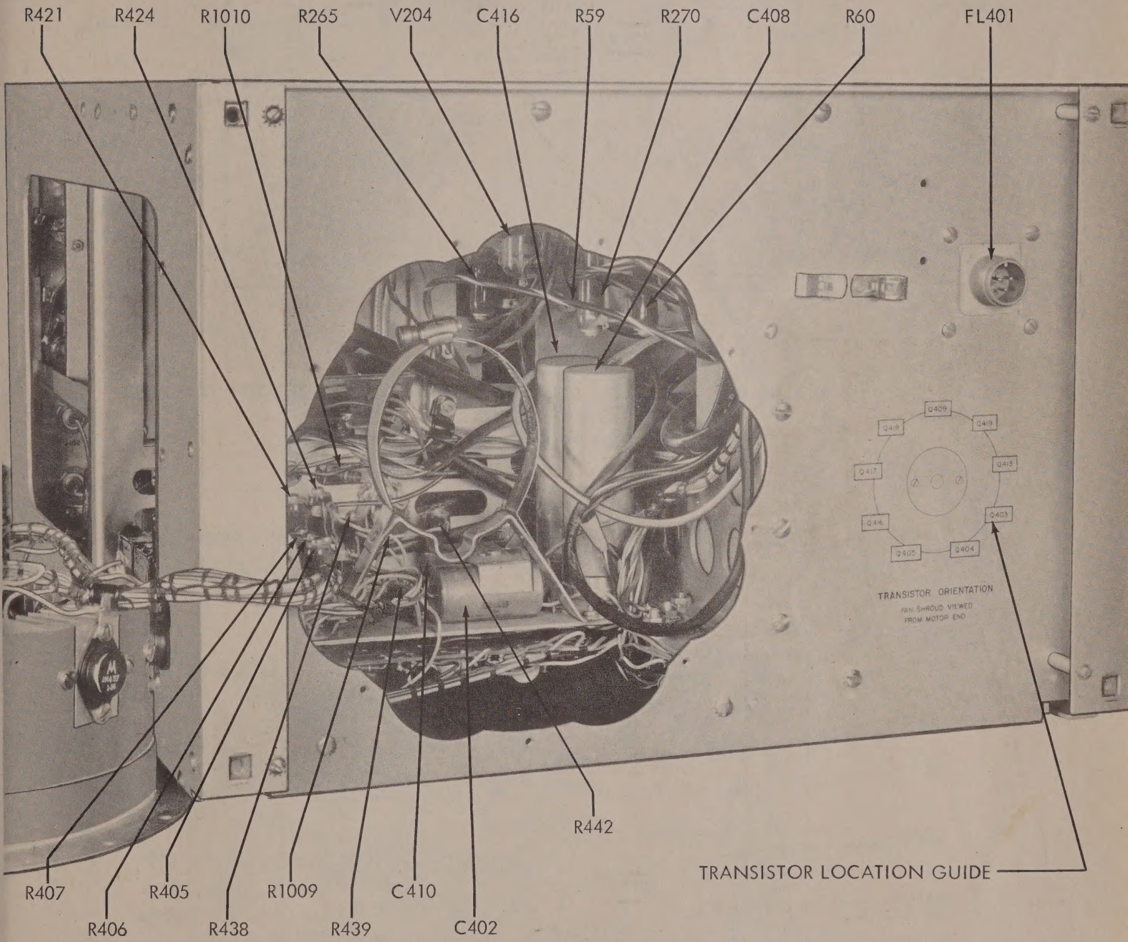

R421
R424
R1010
R265
V204
C416
R59
R270
C408
R60
FL401
Q409
Q418
Q419
Q417
Q413
Q416
Q403
Q405
Q404
TRANSISTOR ORIENTATION
FAN SHROUD VIEWED
FROM MOTOR END
R442
TRANSISTOR LOCATION GUIDE
R407
R405
R1009
C410
R406
R438
R439
C402

Figure 5-10 Location of Internal Parts

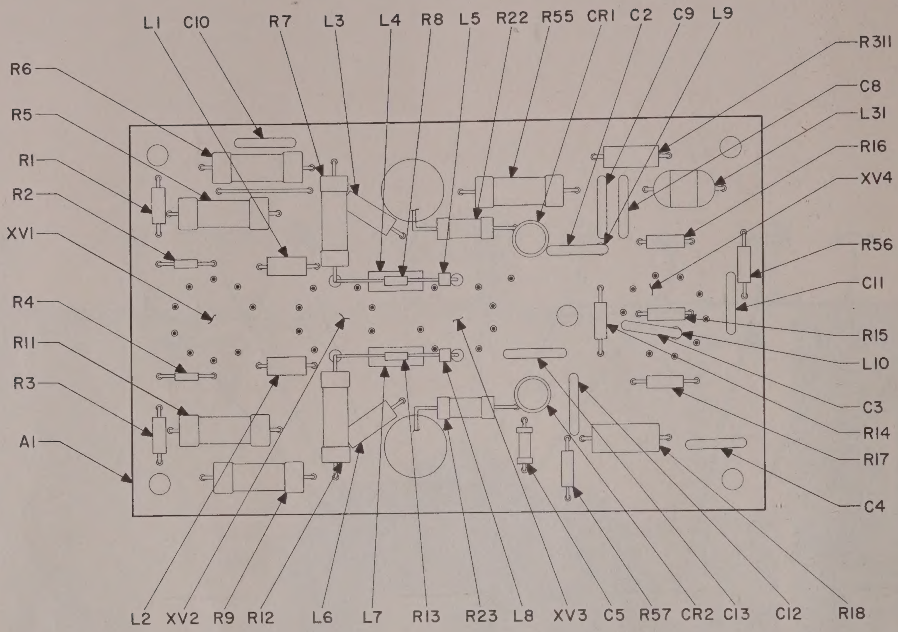

L1
C10
R7
L3
L4
R8
L5
R22
R55
CR1
C2
C9
L9
R311
C8
L31
R16
XV4
R56
C11
R15
L10
C3
R14
R17
C4
R6
R5
R1
R2
XV1
R4
R11
R3
A1
L2
XV2
R9
R12
L6
L7
R13
R23
L8
XV3
C5
R57
CR2
C13
C12
R18

Figure 5-11 Parts Located on Circuit Board A-1

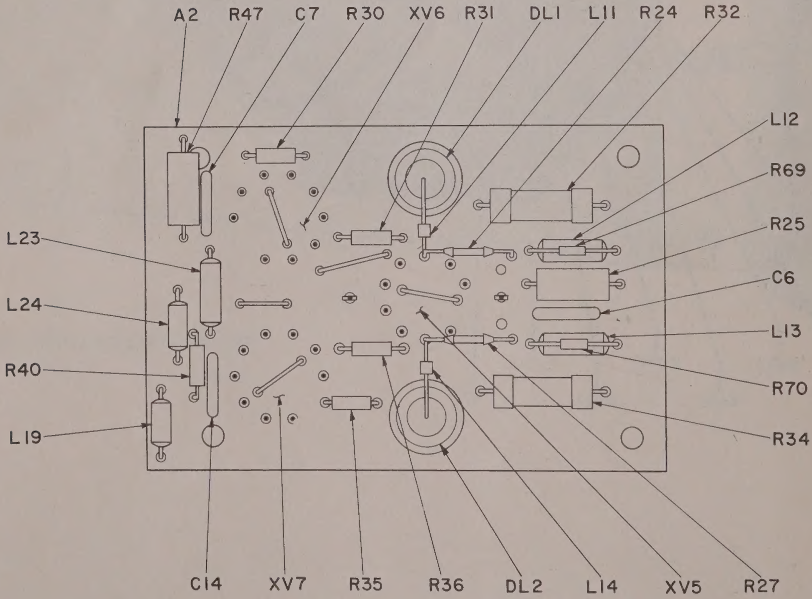

A2
R47
C7
R30
XV6
R31
DL1
L11
R24
R32
L12
R69
R25
C6
L13
R70
R34
L23
L24
R40
L19
C14
XV7
R35
R36
DL2
L14
XV5
R27

Figure 5-12 Parts Located on Circuit Board A2

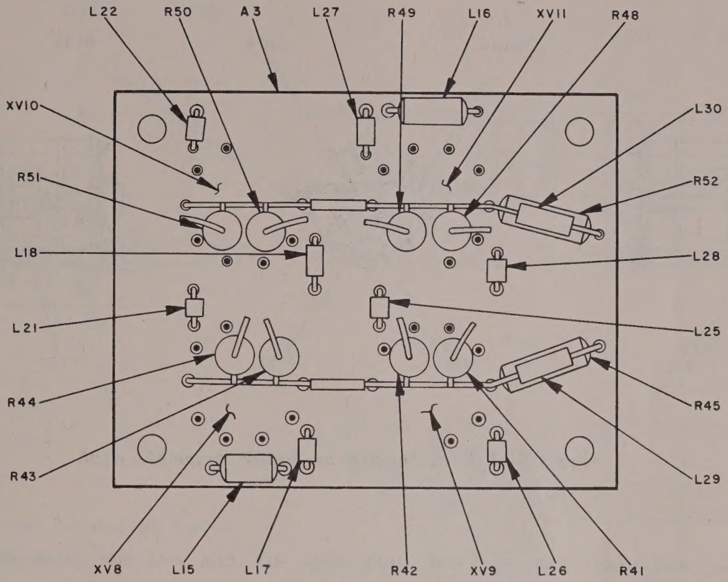

L22
R50
A3
L27
R49
L16
XV11
R48
XV10
L30
R51
R52
L18
L28
L21
L25
R44
R45
R43
L29
XV8
L15
L17
R42
XV9
L26
R41

Figure 5-13 Parts Located on Circuit Board A3

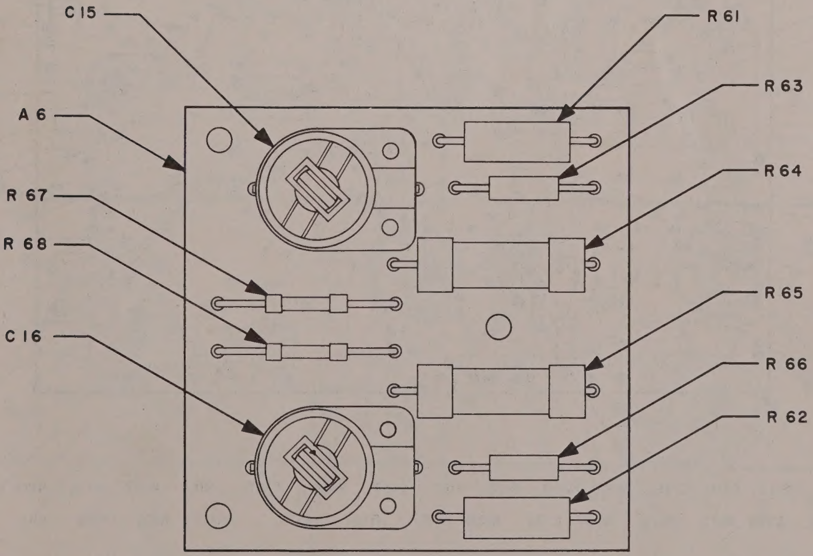

C 15
R 61
R 63
A 6
R 64
R 67
R 68
R 65
C 16
R 66
R 62

Figure 5-14 Parts Located on Circuit Board A6

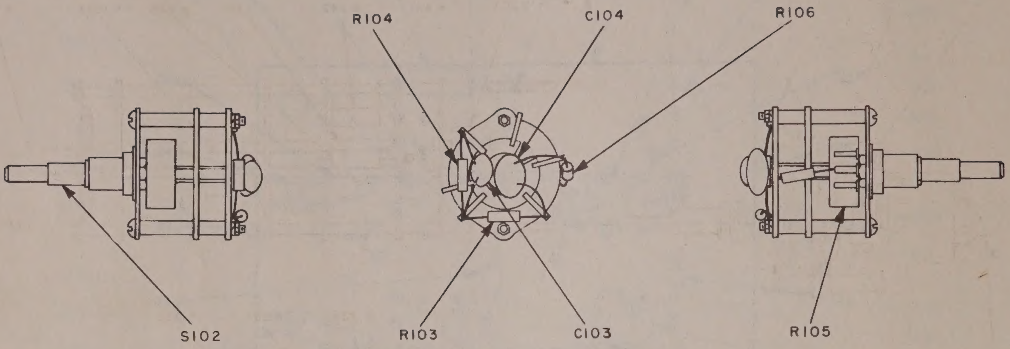

R104
C104
R106
S102
R103
C103
R105

Figure 5-15 Parts Located on Switch Assembly A100

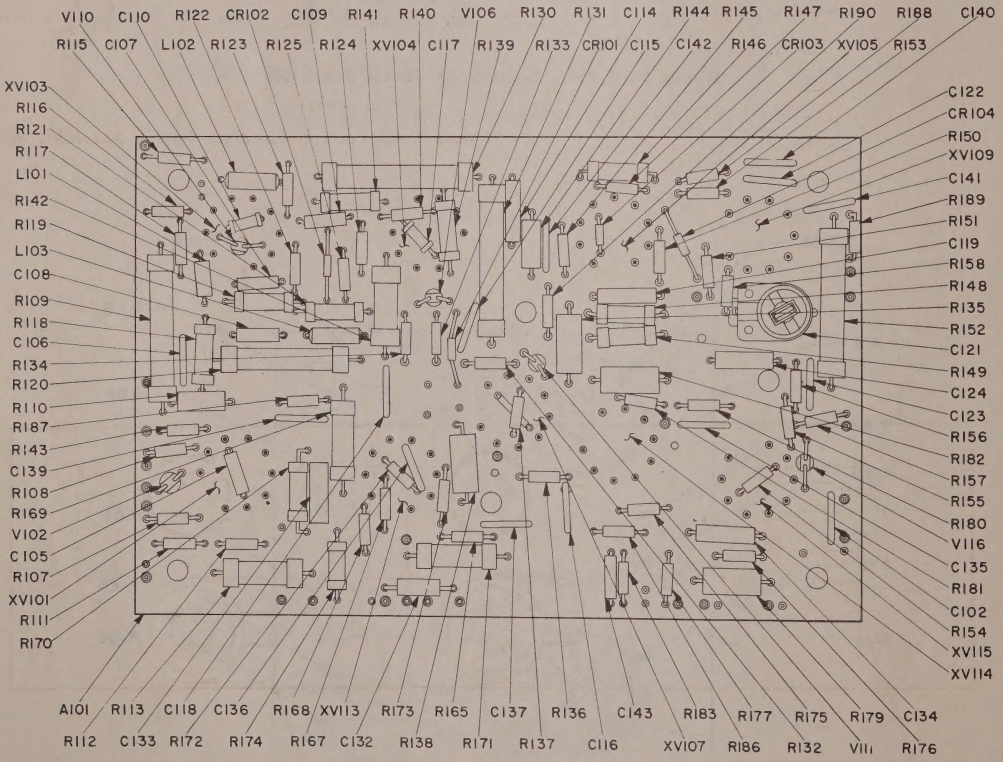

V110
C110
R122
CR102
C109
R141
R140
V106
R130
R131
C114
R144
R145
R147
R190
R188
C140
R115
C107
L102
R123
R125
R124
XV104
C117
R139
R133
CR101
C115
C142
R146
CR103
XV105
R153
XV103
R116
R121
R117
L101
R142
R119
L103
C108
R109
R118
C106
R134
R120
R110
R187
R143
C139
R108
R169
V102
C105
R107
XV101
R111
R170
C122
CR104
R150
XV109
C141
R189
R151
C119
R158
R148
R135
R152
C121
R149
C124
C123
R156
R182
R157
R155
R180
V116
C135
R181
C102
R154
XV115
XV114
A101
R113
C118
C136
R168
XV113
R173
R165
C137
R136
C143
R183
R177
R175
R179
C134
R112
C133
R172
R174
R167
C132
R138
R171
R137
C116
XV107
R186
R132
V111
R176

Figure 5-16 Parts Located on Circuit Board A101

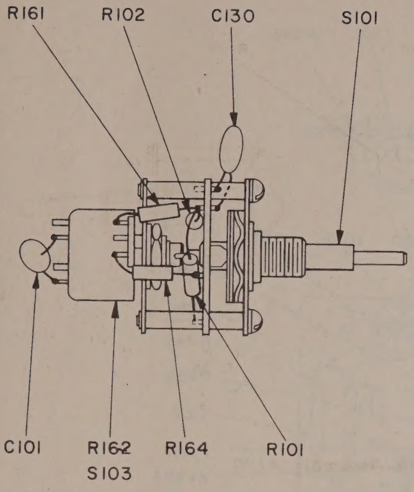

R161
R102
C130
S101
C101
R162
S103
R164
R101

Figure 5-17 Parts Located on Switch Assembly A103

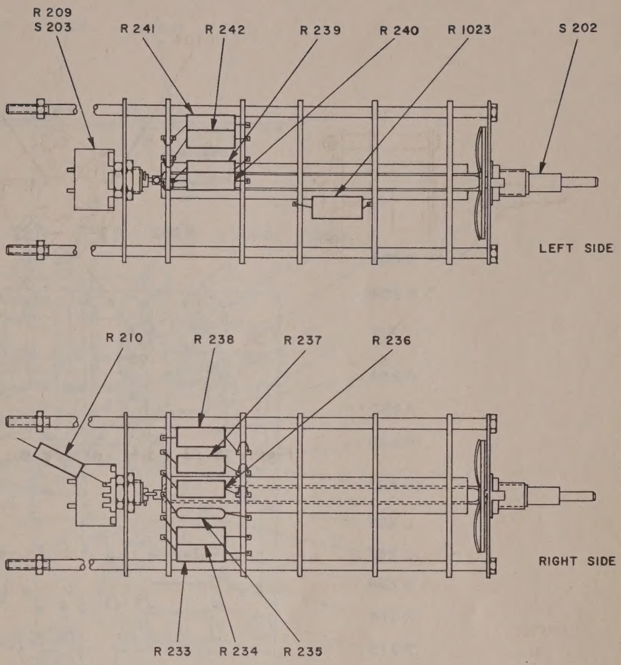

R 209
S 203
R 241
R 242
R 239
R 240
R 1023
S 202
LEFT SIDE
R 210
R 238
R 237
R 236
RIGHT SIDE
R 233
R 234
R 235

Figure 5-18 Parts Located on Switch Assembly A200

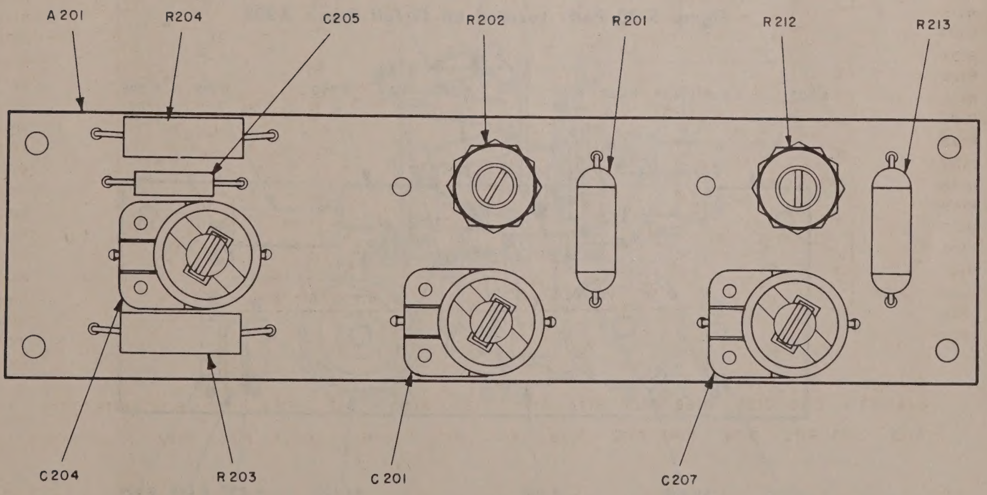

A 201
R204
C205
R202
R201
R212
R213
C204
R 203
C 201
C207

Figure 5-19 Parts Located on Circuit Board A201

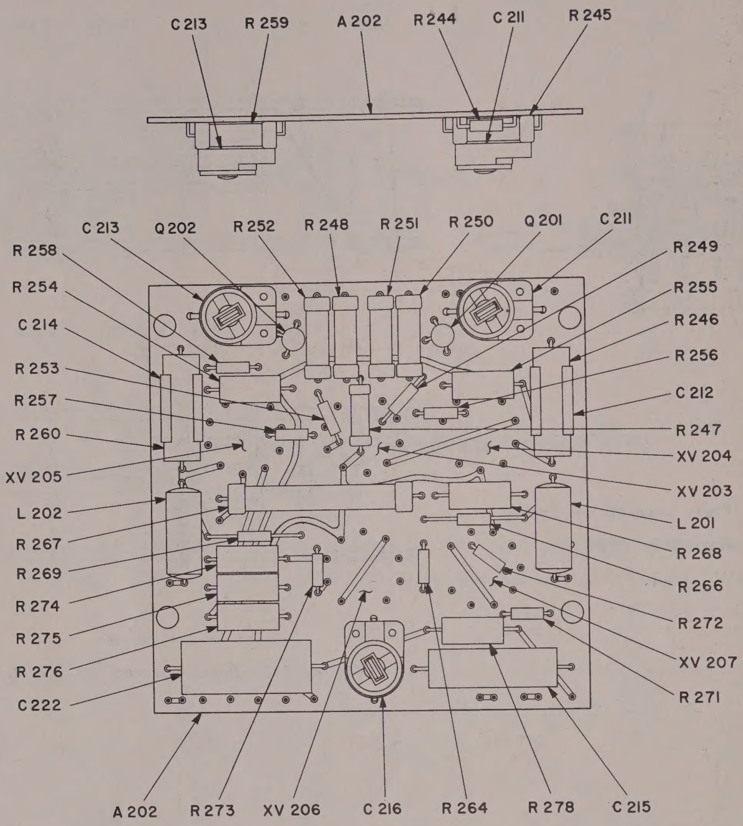

C 213
R 259
A 202
R 244
C 211
R 245
C 213
Q 202
R 252
R 248
R 251
R 250
Q 201
C 211
R 258
R 254
C 214
R 253
R 257
R 260
XV 205
L 202
R 267
R 269
R 274
R 275
R 276
C 222
R 249
R 255
R 246
R 256
C 212
R 247
XV 204
XV 203
L 201
R 268
R 266
R 272
XV 207
R 271
A 202
R 273
XV 206
C 216
R 264
R 278
C 215

Figure 5-20 Parts Located on Circuit Board A202

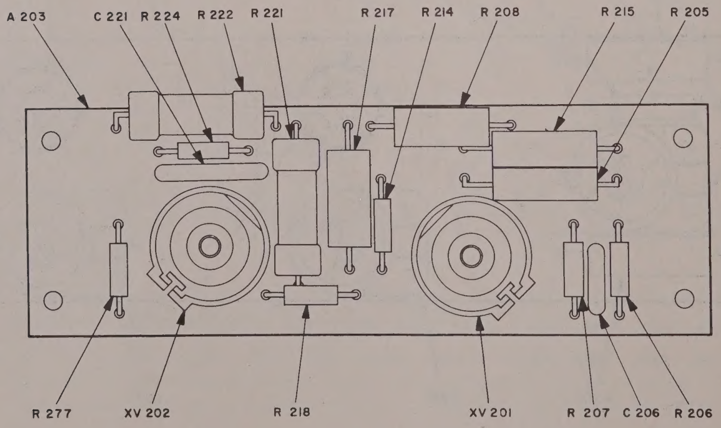

A 203
C 221
R 224
R 222
R 221
R 217
R 214
R 208
R 215
R 205
R 277
XV 202
R 218
XV 201
R 207
C 206
R 206

Figure 5-21 Parts Located on Circuit Board A203

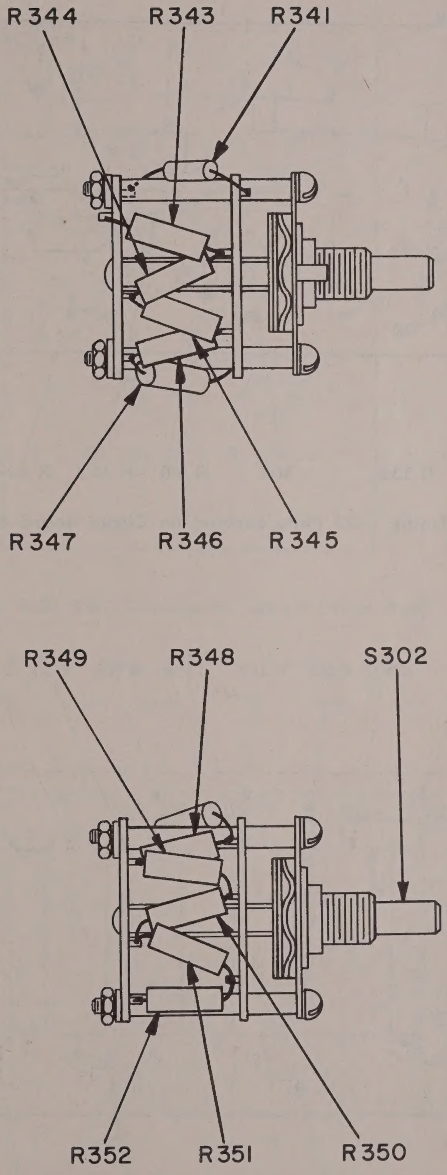

R344
R343
R341
R347
R346
R345
R349
R348
S302
R352
R351
R350

Figure 5-22 Parts Located on Switch Assembly A300

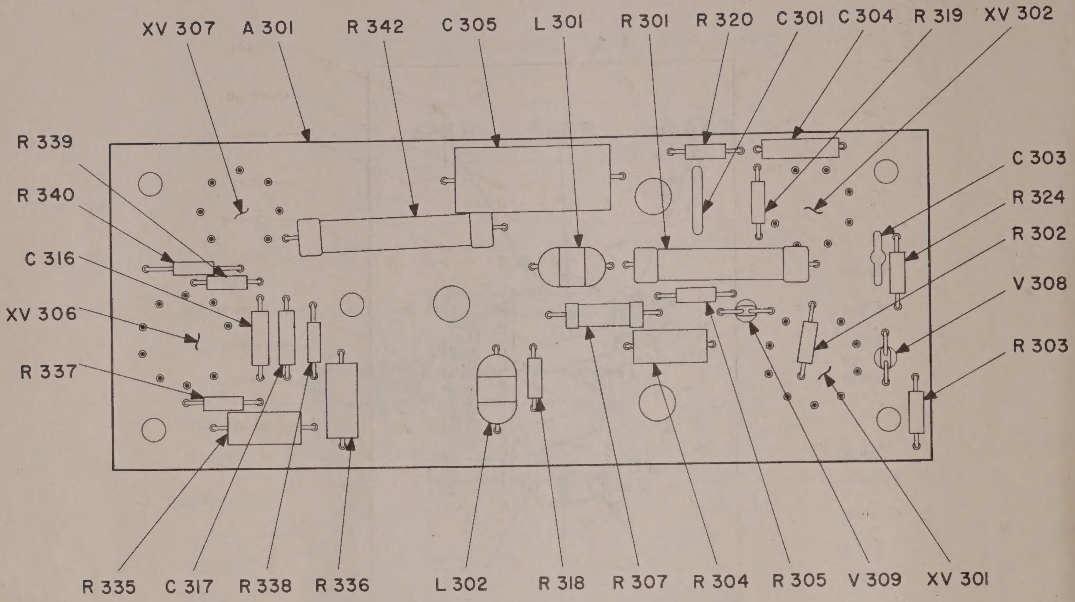

XV 307
A 301
R 342
C 305
L 301
R 301
R 320
C 301
C 304
R 319
XV 302
R 339
R 340
C 316
XV 306
R 337
C 303
R 324
R 302
V 308
R 303
R 335
C 317
R 338
R 336
L 302
R 318
R 307
R 304
R 305
V 309
XV 301

Figure 5-23 Parts Located on Circuit Board A301

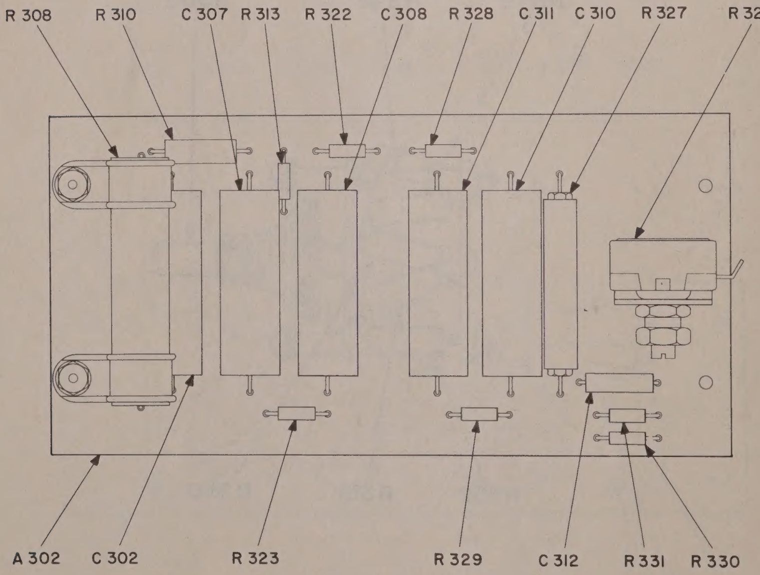

R 308
R 310
C 307
R 313
R 322
C 308
R 328
C 311
C 310
R 327
R 325
A 302
C 302
R 323
R 329
C 312
R 331
R 330

Figure 5-24 Parts Located on Circuit Board A302

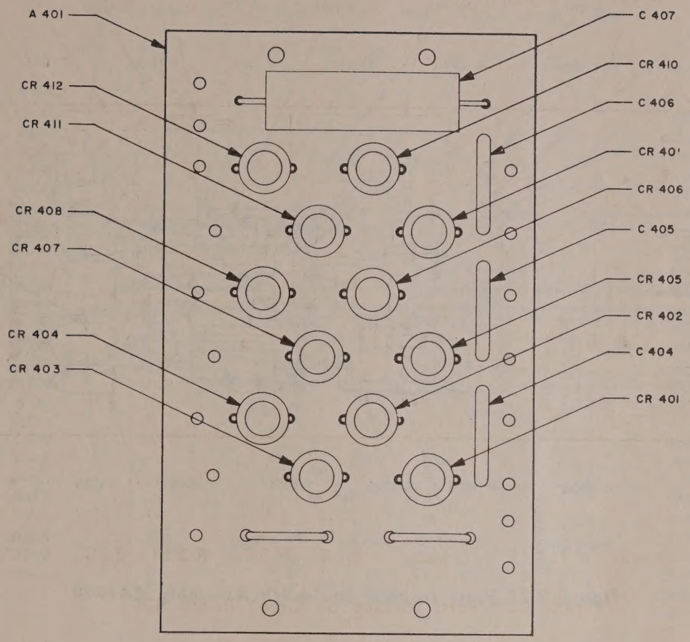

A 401
CR 412
CR 411
CR 408
CR 407
CR 404
CR 403
C 407
CR 410
C 406
CR 409
CR 406
C 405
CR 405
CR 402
C 404
CR 401

Figure 5-25 Parts Located on Circuit Board A401

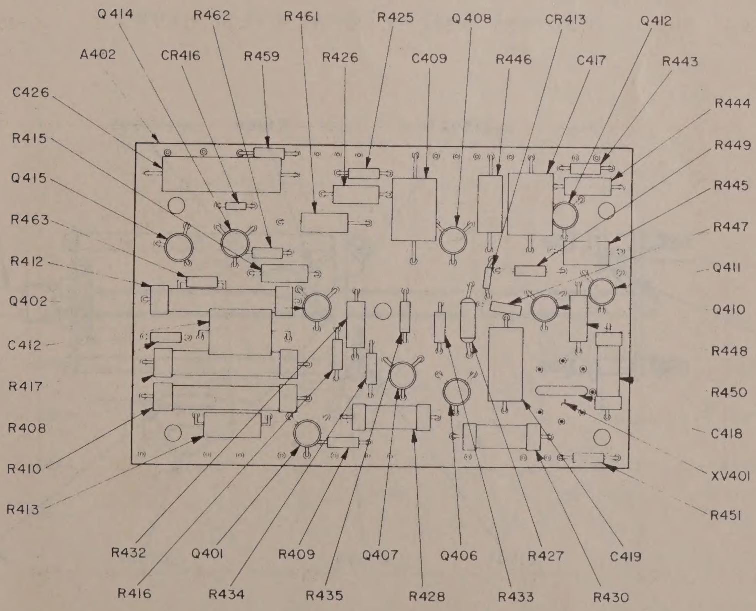

Q414
R462
R461
R425
Q408
CR413
Q412
A402
CR416
R459
R426
C409
R446
C417
R443
C426
R415
Q415
R463
R412
Q402
C412
R417
R408
R410
R413
R444
R449
R445
R447
Q411
Q410
R448
R450
C418
XV401
R451
R432
Q401
R409
Q407
Q406
R427
C419
R416
R434
R435
R428
R433
R430

Figure 5-26 Parts Located on Circuit Board A402

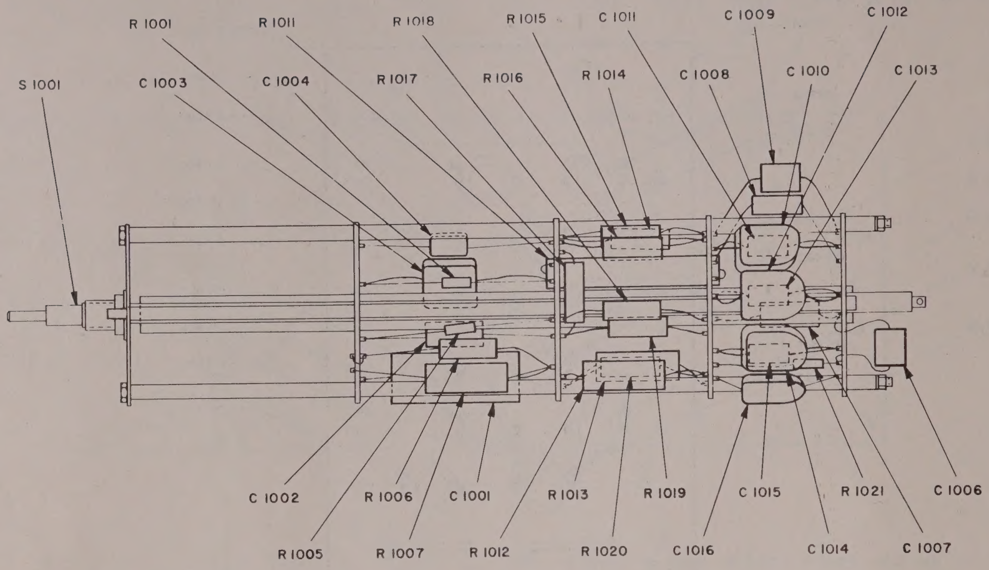

R 1001
R 1011
R 1018
R 1015
C 1011
C 1009
C 1012
S 1001
C 1003
C 1004
R 1017
R 1016
R 1014
C 1008
C 1010
C 1013
C 1002
R 1006
C 1001
R 1013
R 1019
C 1015
R 1021
C 1006
R 1005
R 1007
R 1012
R 1020
C 1016
C 1014
C 1007

Figure 5-27 Parts Located on Switch Assembly AA1000

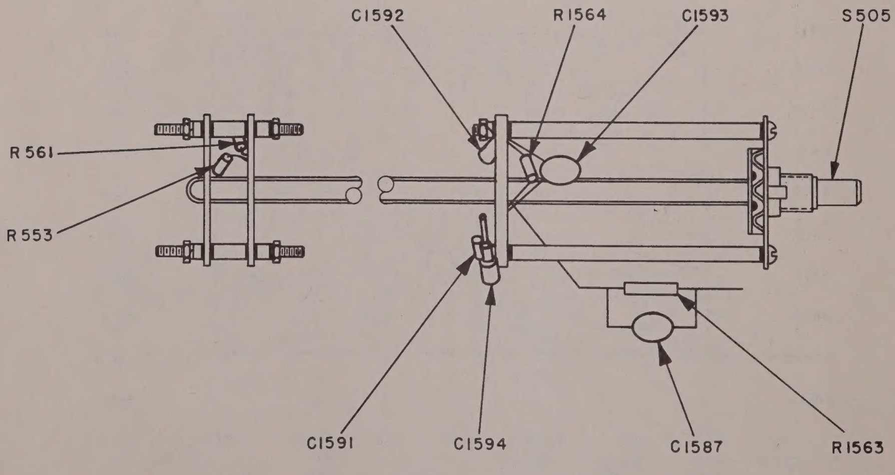

C1592
R1564
C1593
S505
R561
R553
C1591
C1594
C1587
R1563

Figure 5-28 Parts Located on Switch Assembly A500

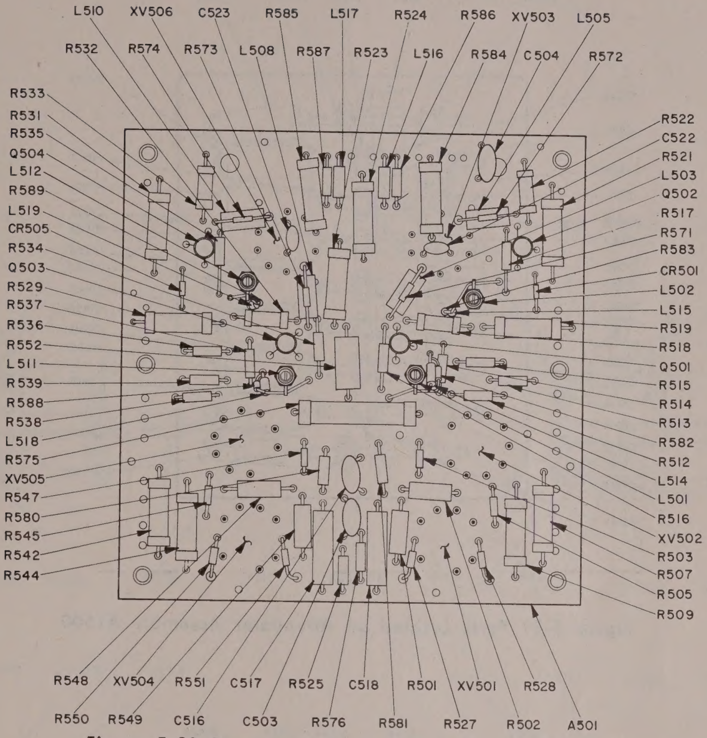

L510
XV506
C523
R585
L517
R524
R586
XV503
L505
R532
R574
R573
L508
R587
R523
L516
R584
C504
R572
R533
R531
R535
Q504
L512
R589
L519
CR505
R534
Q503
R529
R537
R536
R552
L511
R539
R588
R538
L518
R575
XV505
R547
R580
R545
R542
R544
R522
C522
R521
L503
Q502
R517
R571
R583
CR501
L502
L515
R519
R518
Q501
R515
R514
R513
R582
R512
L514
L501
R516
XV502
R503
R507
R505
R509
R548
XV504
R551
C517
R525
C518
R501
XV501
R528
R550
R549
C516
C503
R576
R581
R527
R502
A501

Figure 5-29 Parts Located on Circuit Board A501

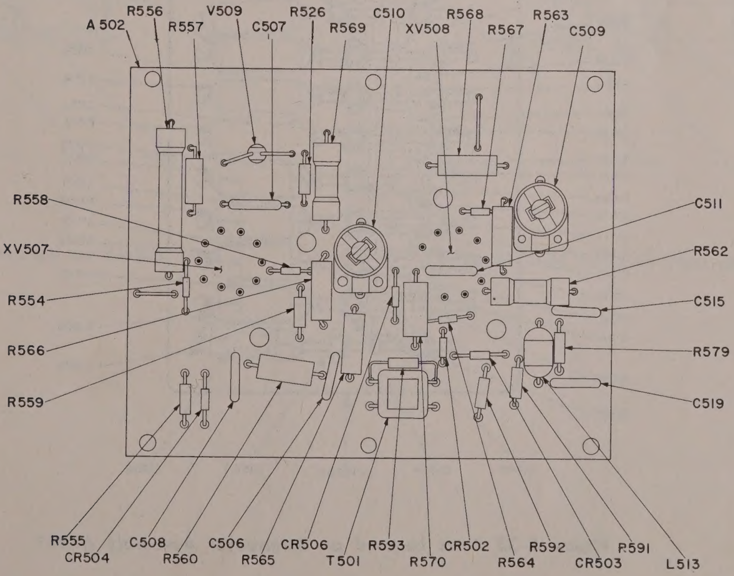

R556
V509
R526
C510
R568
R563
A 502
R557
C507
R569
XV508
R567
C509
R558
XV507
R554
R566
R559
C511
R562
C515
R579
C519
R555
CR504
C508
R560
C506
R565
CR506
T501
R593
R570
CR502
R564
R592
CR503
R591
L513

Figure 5-30 Parts Located on Circuit Board A502

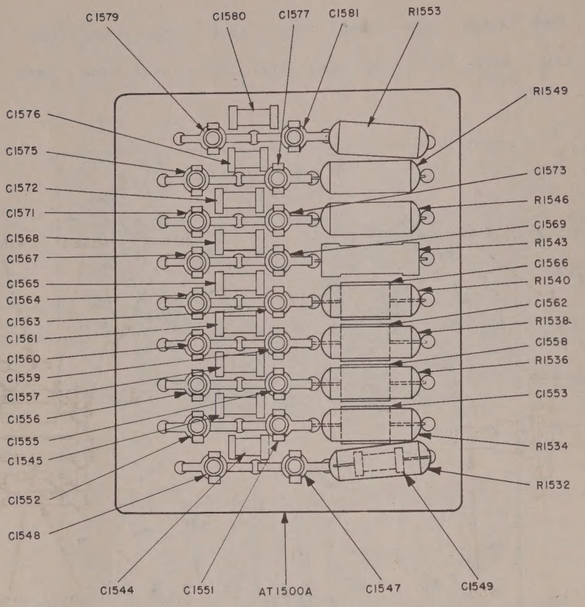

C1579
C1580
C1577
C1581
R1553
R1549
C1576
C1575
C1572
C1571
C1568
C1567
C1565
C1564
C1563
C1561
C1560
C1559
C1557
C1556
C1555
C1545
C1552
C1548
C1573
R1546
C1569
R1543
C1566
R1540
C1562
R1538
C1558
R1536
C1553
R1534
R1532
C1544
C1551
AT1500A
C1547
C1549

Figure 5-31 Parts Located on Attenuator Assembly A1500

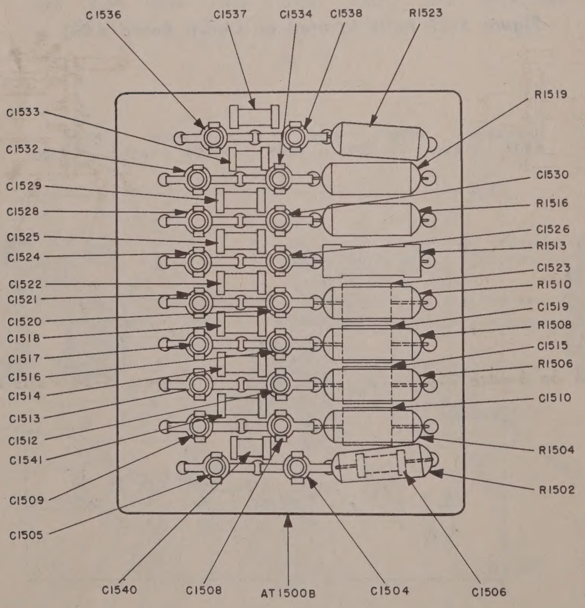

C1536
C1537
C1534
C1538
R1523
R1519
C1533
C1532
C1529
C1528
C1525
C1524
C1522
C1521
C1520
C1518
C1517
C1516
C1514
C1513
C1512
C1541
C1509
C1505
C1530
R1516
C1526
R1513
C1523
R1510
C1519
R1508
C1515
R1506
C1510
R1504
R1502
C1540
C1508
AT1500B
C1504
C1506

Figure 5-32 Parts Located on Attenuator Assembly A1501

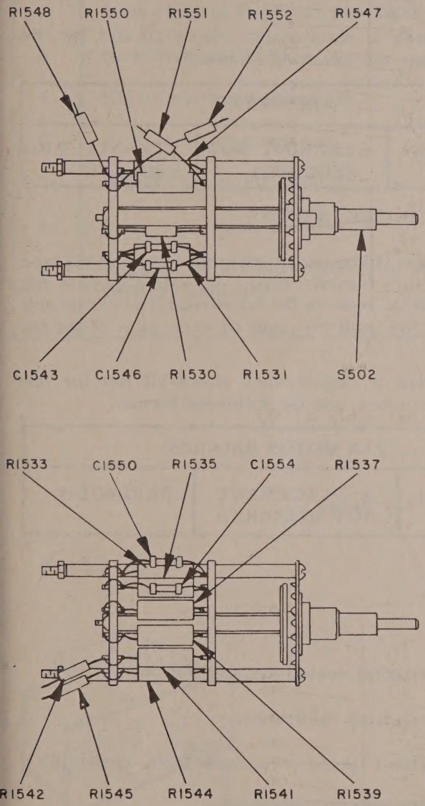

R1548
R1550
R1551
R1552
R1547
C1543
C1546
R1530
R1531
S502
R1533
C1550
R1535
C1554
R1537
R1542
R1545
R1544
R1541
R1539

Figure 5-33 Parts Located on Switch S502

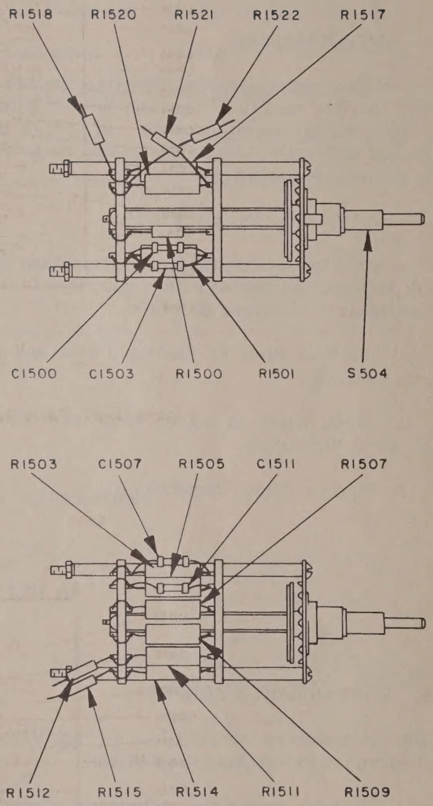

R1518
R1520
R1521
R1522
R1517
C1500
C1503
R1500
R1501
S504
R1503
C1507
R1505
C1511
R1507
R1512
R1515
R1514
R1511
R1509

Figure 5-34 Parts Located on Switch S504

SECTION 6
SERVICE AND REPAIR

6A PREVENTIVE MAINTENANCE

6-1. INTRODUCTION.

Preventive maintenance for Oscilloscope AN/USM-105A consists mainly of cleaning the air filter and checking the fan motor brushes. In addition the instrument should be given an occasional visual inspection for potential sources of trouble.

6-2. SERVICING THE AIR FILTER.

The air filter is located on the rear of the instrument cabinet. Inspect the filter and clean it as often as necessary. Proceed as follows:

(1) Remove filter by pushing it down and pulling on its top edge.

(2) Wash filter in warm water and detergent; then dry it thoroughly.

(3) Apply coating compound.

To prepare a maintenance check-off list for the air filter, use the following format:

AIR FILTER		
WEEK OF	CLEANING NOT REQUIRED	CLEANED AND RECOATED

6-3. FAN MOTOR BRUSHES.

Inspect the fan motor brushes monthly and replace them when they become worn. To gain access to the motor brushes, remove the fan shroud (see paragraph 6-13) and the knurled caps on each side of the fan motor.

To prepare a maintenance check-off list for the fan motor brushes, use the following format:

FAN MOTOR BRUSHES		
MONTH	REPLACEMENT NOT REQUIRED	REPLACED

6B REFERENCE STANDARDS

6-4. PERFORMANCE CHECKS.

The performance of Oscilloscope AN/USM-105A is determined by checking the following:

(1) Vertical sensitivity calibration (both channels).

(2) Calibrator calibration.

(3) Horizontal sensitivity calibration.

(4) Sweep time calibration.

(5) Vertical pulse response (both channels).

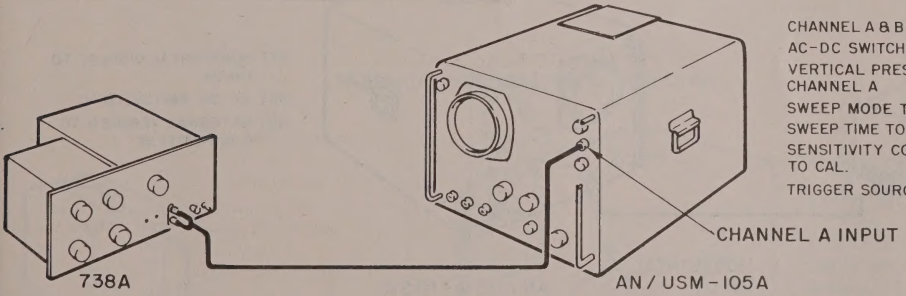
(6) Sweep trigger sensitivity.

The checks should be made in the listed sequence except that the calibrator can be checked first. Then the calibrator can be used as the reference voltage.

TABLE 6-1 TEST EQUIPMENT AND SPECIAL TOOLS

Item	Function	Description	Number
1	Precise dc voltage measurements	Electronic Multimeter	Fluke 801 or Fluke 803
2	High voltage measurements	Electronic Multimeter with High Voltage Probe	AN/USM-116
3	Main vertical amplifier gain calibration	Electronic AC Voltmeter	Hewlett-Packard 400H
4	Sensitivity calibration	Voltmeter Calibrator	Hewlett-Packard 738A
5	High frequency calibration	Square Wave Generator	Tektronix 107
6	Frequency compensation	Square Wave Generator	Hewlett-Packard 211A
7	Sweep time calibration	Time Mark Generator	Tektronix 180A
8	Input capacitance calibration	L-C Meter	AN/URM-90
9	Application of signal directly to main vertical amplifier	Special test plug-in unit	To be constructed at test station (see Figure 6-1)

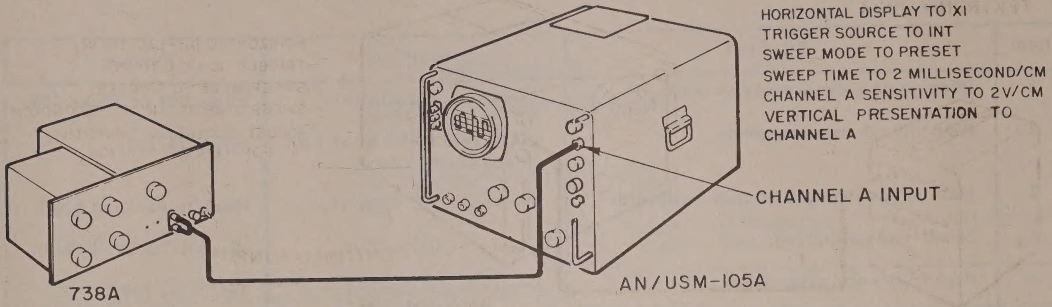
TABLE 6-2 VERTICAL SENSITIVITY CALIBRATION



CHANNEL A & B VERNIER TO CAL.
AC-DC SWITCH TO AC
VERTICAL PRESENTATION TO CHANNEL A
SWEEP MODE TO PRESET
SWEEP TIME TO 5 MILLISECONDS/CM
SENSITIVITY CONTROL VERNIER TO CAL.
TRIGGER SOURCE TO INT

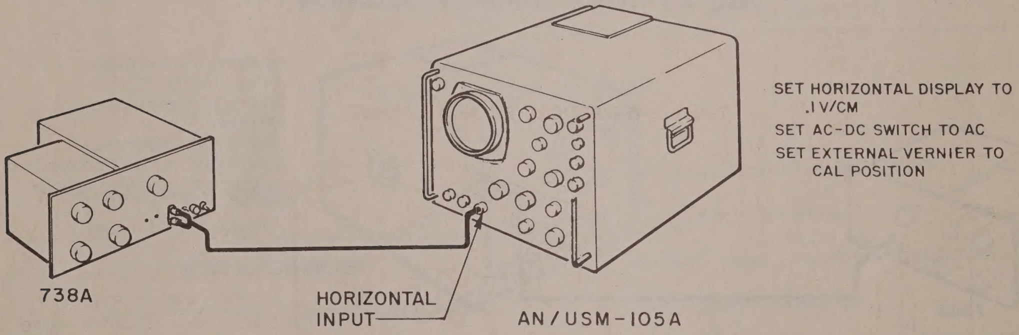
STEP	PRELIMINARY ACTION	READ INDICATION ON	REFERENCE STANDARD
1	Set 738A to 400 cycle peak-to-peak at 0.1 volt output. Set SENSITIVITY to .02V/CM.	AN/USM-105A	5 centimeters deflection ±3% over temperature and humicity range III
2	Perform check for each position of SENSITIVITY control; set 738A output to provide necessary signal output for adequate deflection to accurately check attenuator.	AN/USM-105A	Tolerance in all positions is ±3% over temperature and humidity range III
3	Repeat for channel "B".		

TABLE 6-3 CALIBRATOR CALIBRATION


HORIZONTAL DISPLAY TO XI
TRIGGER SOURCE TO INT
SWEEP MODE TO PRESET
SWEEP TIME TO 2 MILLISECOND/CM
CHANNEL A SENSITIVITY TO 2V/CM
VERTICAL PRESENTATION TO CHANNEL A
CHANNEL A INPUT
738A
AN/USM-105A

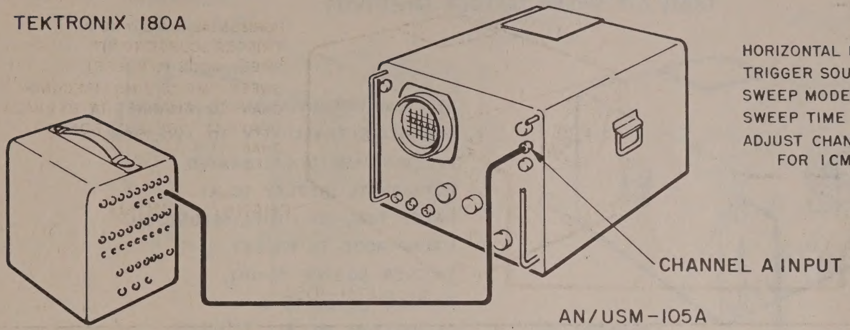
STEP	PRELIMINARY ACTION	READ INDICATION ON	REFERENCE STANDARD
1	Set 738A for 10-volt, 400 cycle peak-to-peak output and connect it to channel A INPUT.	AN/USM-105A	Note amplitude on CRT.
2	Disconnect 738A. Set CALIBRATOR for 10-volt output and connect it to channel A INPUT. Adjust VERTICAL POSITION controls as necessary.	AN/USM-105A	Less than 3% error between amplitudes of sine wave and square wave.
3	Checks for all CALIBRATOR ranges can be made by comparing equivalent voltages of the 738A and CALIBRATOR.		

TABLE 6-4 HORIZONTAL SENSITIVITY CALIBRATION


SET HORIZONTAL DISPLAY TO .1V/CM
SET AC-DC SWITCH TO AC
SET EXTERNAL VERNIER TO CAL POSITION
738A
HORIZONTAL INPUT
AN/USM-105A

STEP	PRELIMINARY ACTION	READ INDICATION ON	REFERENCE STANDARD
1	Connect 1 volt peak-to-peak from 738A to horizontal INPUT. Adjust position controls to center horizontal trace.	AN/USM-105A	Trace extends 10 MC ±3%
2	Turn HORIZONTAL DISPLAY to .2V/CM	AN/USM-105A	Trace extends 5 CM ±3%
3	Turn HORIZONTAL DISPLAY to .5V/CM	AN/USM-105A	Trace extends 2 CM ±3%
4	Continue test for each position of HORIZONTAL DISPLAY control, increasing peak-to-peak signal from 738A as necessary.		

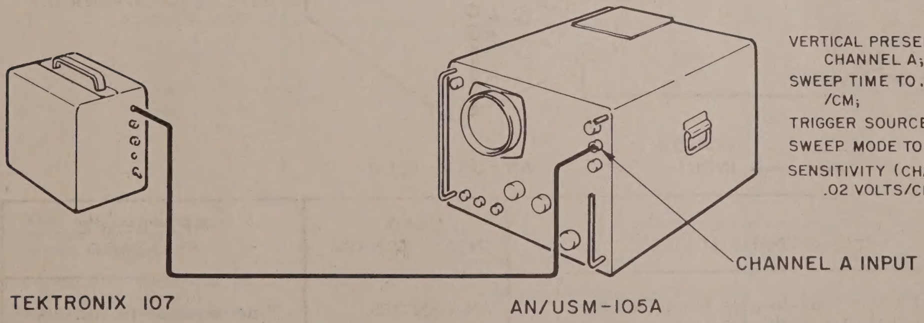
TABLE 6-5 SWEEP TIME CALIBRATION



HORIZONTAL DISPLAY TO X1;
TRIGGER SOURCE TO INT;
SWEEP MODE TO TRIGGER;
SWEEP TIME TO 1 MICROSECOND/CM
ADJUST CHANNEL A SENSITIVITY
FOR 1CM DEFLECTION

STEP	PRELIMINARY ACTION	READ INDICATION ON	REFERENCE STANDARD
1	Connect 1 μsec time-marks from 180A to channel A input.	AN/USM-105A	1 marker/CM ±3%
2	Turn SWEEP TIME control to 1 MILLISECOND/CM position; then to 1 SECOND/CM position. Set 180A to produce corresponding time-marker for each position of SWEEP TIME control.	AN/USM-105A	1 marker/CM ±3%

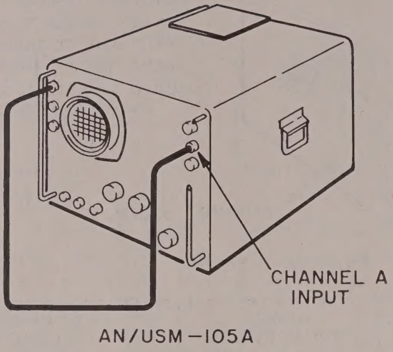
TABLE 6-6 VERTICAL PULSE RESPONSE



VERTICAL PRESENTATION TO
CHANNEL A;
SWEEP TIME TO .2 MICROSECOND
/CM;
TRIGGER SOURCE TO INT;
SWEEP MODE TO PRESET;
SENSITIVITY (CHANNEL A) TO
.02 VOLTS/CM

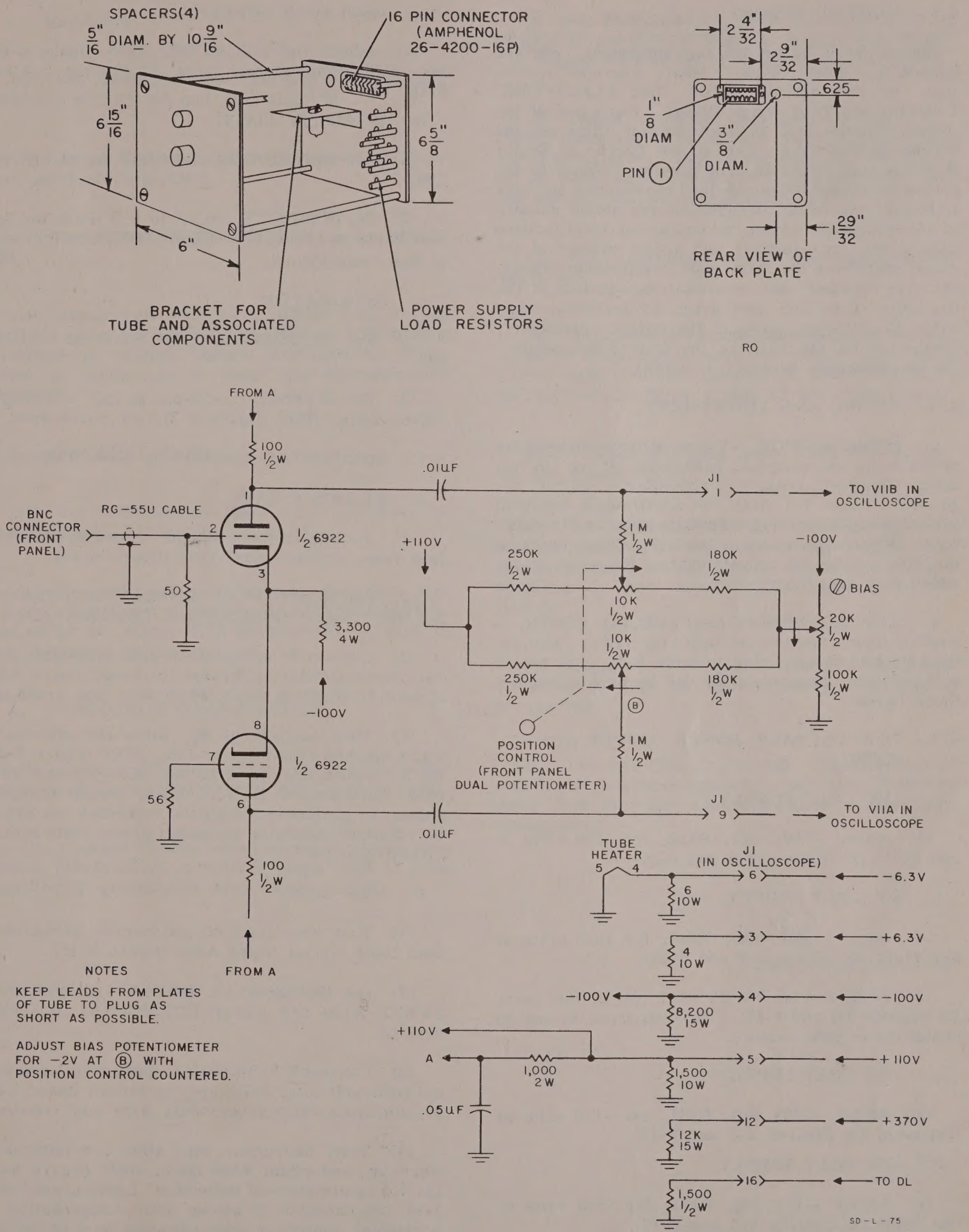
STEP	PRELIMINARY ACTION	READ INDICATION ON	REFERENCE STANDARD
1	Connect signal from Square-Wave Generator to channel A INPUT. Output signal should be 0.25 volt ac, peak-to-peak, 500 kc.	AN/USM-105A	Overshoot on leading edge of applied signal must not exceed 1%.

TABLE 6-7 SWEEP TRIGGER SENSITIVITY



VERTICAL PRESENTATION TO CHANNEL A
CHANNEL A SENSITIVITY TO 1 VOLT/CM,
VERNIER TO CALIBRATED
HORIZONTAL DISPLAY TO X1
SWEEP TIME TO 1 MILLISECOND/CM
SWEEP MODE TO PRESET
TRIGGER SOURCE TO INT.
TRIGGER LEVEL TO 0
CALIBRATOR TO .5

STEP	PRELIMINARY ACTION	READ INDICATION ON	REFERENCE STANDARD
1	Connect VOLTS terminal of calibrator to channel A INPUT.	AN/USM-105A	Sweep triggered without jitter.


SPACERS(4)
$\frac{5}{16}$" DIAM. BY $10\frac{9}{16}$"
16 PIN CONNECTOR
(AMPHENOL
26-4200-16P)
$6\frac{15}{16}$"
$6\frac{5}{8}$"
6"
BRACKET FOR
TUBE AND ASSOCIATED
COMPONENTS
POWER SUPPLY
LOAD RESISTORS
$2\frac{4}{32}$"
$2\frac{9}{32}$"
.625
$\frac{1}{8}$" DIAM
$\frac{3}{8}$" DIAM.
PIN (1)
$1\frac{29}{32}$"
REAR VIEW OF
BACK PLATE
RO
FROM A
100
½W
.01UF
J1
1
TO VIIB IN
OSCILLOSCOPE
BNC
CONNECTOR
(FRONT
PANEL)
RG-55U CABLE
1
2
3
½ 6922
50
+110V
1 M
½W
250K
½W
180K
½W
-100V
BIAS
10K
½W
20K
½W
10K
½W
100K
½W
3,300
4W
-100V
250K
½W
180K
½W
B
8
POSITION
CONTROL
(FRONT PANEL
DUAL POTENTIOMETER)
1 M
½W
7
½ 6922
56
6
J1
9
TO VIIA IN
OSCILLOSCOPE
.01UF
TUBE
HEATER
5
4
J1
(IN OSCILLOSCOPE)
6
-6.3V
6
10W
100
½W
3
+6.3V
4
10W
FROM A
-100V
4
-100V
8,200
15W
+110V
A
1,000
2W
5
+ 110V
1,500
10W
.05UF
12
+370V
12K
15W
16
TO DL
1,500
½W
SD-L-75

NOTES

KEEP LEADS FROM PLATES OF TUBE TO PLUG AS SHORT AS POSSIBLE.

ADJUST BIAS POTENTIOMETER FOR -2V AT Ⓑ WITH POSITION CONTROL COUNTERED.

Figure 6-1 Special Vertical Test Plug-in

6-5. FAILURE REPORT.

Report each failure of the equipment, whether caused by a defective part, wear, improper operation, or an external cause. Use ELECTRONIC FAILURE REPORT Form DD787. Each pad of the forms includes full instructions for filling out the forms and forwarding them to the Bureau of Ships. However, the importance of providing complete information cannot be emphasized too much. Be sure to include the model designation and serial number of the equipment (from the equipment identification plate), the type number and serial number of the major unit (from the major unit identification plate), the type number and reference designation of the particular defective part (from the technical manual). Describe the cause of the failure completely, continuing on the back of the form if necessary. Do not substitute brevity for clarity.

6.6. TUNING AND ADJUSTMENT.

a. INTRODUCTION. - The procedures below give instructions for complete calibration of the instrument. However, complete calibration is seldom required. Table 3-1 lists the adjustments required following replacement of individual tubes and transistors. Whether complete or partial calibration is to be done, make the adjustments in the sequence in which they are given below.

b. TEST EQUIPMENT AND SPECIAL TOOLS. - Test equipment and special tools required to complete the adjustments are listed in table 6-1. Equipment of equivalent characteristics can be substituted for those listed.

6-7. LOW VOLTAGE POWER SUPPLY ADJUSTMENT.

a. -100 VOLT SUPPLY.

(1) Adjust -100V Adj, R452, for -100 volts at test point D3 (figures 5-3 and 6-17).

b. 6.3 VOLT SUPPLY.

(1) Adjust ~~100V~~ 6.3V Adj, R464, for +6.3 volts at test point D2 (figure 5-3 and 6-17).

(2) Check for -6.3 volts +0.1 volt at test point D1 (figures 5-3 and 6-17). Any unbalance is due to unbalance in tube heaters.

c. +110 VOLT SUPPLY.

(1) Adjust +110V Adj, R431, for +110 volts at test point D4 (figures 5-3 and 6-17).

d. +370 VOLT SUPPLY.

(1) Adjust +370V Adj, R411, for +370 volts at test point D5 (figures 5-3 and 6-17).

6-8. HIGH VOLTAGE POWER SUPPLY ADJUSTMENT.

a. -4800 VOLT SUPPLY.

(1) Adjust High Voltage Adj, R306 (figure 6-2), for -4800 volts at test point F1 (figures 5-4 and 6-16).

b. INTENSITY LIMIT.

(1) Set HORIZONTAL DISPLAY to 10 VOLTS/CM.

(2) Set INTENSITY control to 9 o'clock and adjust Intensity Limit, R325 (figure 6-2), so CRT beam is just extinguished.

c. ASTIGMATISM.

(1) Set HORIZONTAL DISPLAY to 10 VOLTS/CM.

(2) Set INTENSITY so spot is just visible and adjust Astig. R312 (figure 6-2), for round spot.

6-9. HORIZONTAL AMPLIFIER ADJUSTMENT.

a. X1 SWEEP GAIN.

(1) Turn instrument off and remove green/white lead from circuit board A201 (figure 6-15).

(2) Set HORIZONTAL DISPLAY to INTERNAL X1 and center HORIZONTAL POSITION control.

(3) Connect 50 volt peak-to-peak sine-wave signal from voltmeter calibrator to circuit board A201 at point from which green/white wire was removed.

(4) Turn instrument on, allow few minutes to warm up, and adjust Sweep Gain, R202 (figure 6-3). for 5.5 centimeters of deflection. Leave green/white lead disconnected if X100 Gain, Sweep Compensation, or horizontal amplifier compensation are to be adjusted; otherwise reconnect green/white lead to circuit board A201.

b. X100 GAIN.

(1) Turn instrument off and remove green/white lead from circuit board A201 (figure 6-15).

(2) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X100 and center HORIZONTAL POSITION control.

(3) Connect 0.5 volt peak-to-peak sine-wave signal from voltmeter calibrator to circuit board A201 at point from which green/white wire was removed.

(4) Turn instrument on, allow few minutes to warm up, and adjust X100 Gain, R223 (figure 6-3), for 5.5 centimeters of deflection. Leave green/white lead disconnected if sweep gain compensation or horizontal amplifier compensation are to be adjusted; otherwise, connect green/white lead to circuit board A201.

c. BALANCE.

(1) Set HORIZONTAL DISPLAY between INTERNAL SWEEP X1 and .1 VOLT/CM.

(2) Adjust Horiz Bal, R243 (figure 6-3) to center spot horizontally on CRT.

(3) Set HORIZONTAL DISPLAY to .1 VOLT/CM.

(4) Adjust Vern Bal, R211 (figure 6-3), for no shift or spot horizontally on CRT as EXTERNAL VERNIER is rotated. Adjust HORIZONTAL POSITION as necessary to keep spot approximately centered.

d. EXTERNAL GAIN.

(1) Set HORIZONTAL DISPLAY to .1 VOLT/CM and horizontal AC-DC switch to AC.

(2) Connect 1 volt peak-to-peak sine-wave signal from voltmeter calibrator to horizontal INPUT, and adjust Ext. Gain, R212 (figure 6-3), to give 10 cm horizontal deflection.

e. FREQUENCY COMPENSATION.

(1) Turn instrument off and disconnect green/white lead from circuit board A201 (figure 6-15).

(2) Connect 75-ohm output of square-wave generator (28480-211A) to circuit board A201 at point from which green/white lead was removed.

(3) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X5 and SWEEP TIME to .5 MILLISECONDS/CM; connect SWEEP OUTPUT to Channel A INPUT.

(4) Connect a coaxial cable between the SYNC. INPUT connector of the square wave generator and the external sync. INPUT connector on the 105A. Set the 105A TRIGGER SOURCE switch to EXT AC and SWEEP MODE control to PRESET.

(5) Turn instrument on and allow few minutes' warm up.

(6) Set square wave generator output to 4KC and adjust its amplitude to make the square wave about 3 cm wide. Adjust Channel A SENSITIVITY to display two or three cycles of the square wave.

(7) Adjust Sweep Gain Comp. C201 (figure 6-3), for flat square wave.

(8) Set HORIZONTAL DISPLAY to X10 and SWEEP TIME to 20 usec/cm; change square-wave generator output to 100 kc and adjust square-wave amplitude to give wave waveform about 5 cm deflection.

(9) Adjust L. F. Comp. capacitors C211 and C213 (figure 6-2) for approximately a flat topped square wave.

(10) Increase Cap. Driver Adj. C216 (figure 6-2) until some overshoot appears on left side of square wave; then decrease adjustment until overshoot just disappears.

(continued on page 6-10)

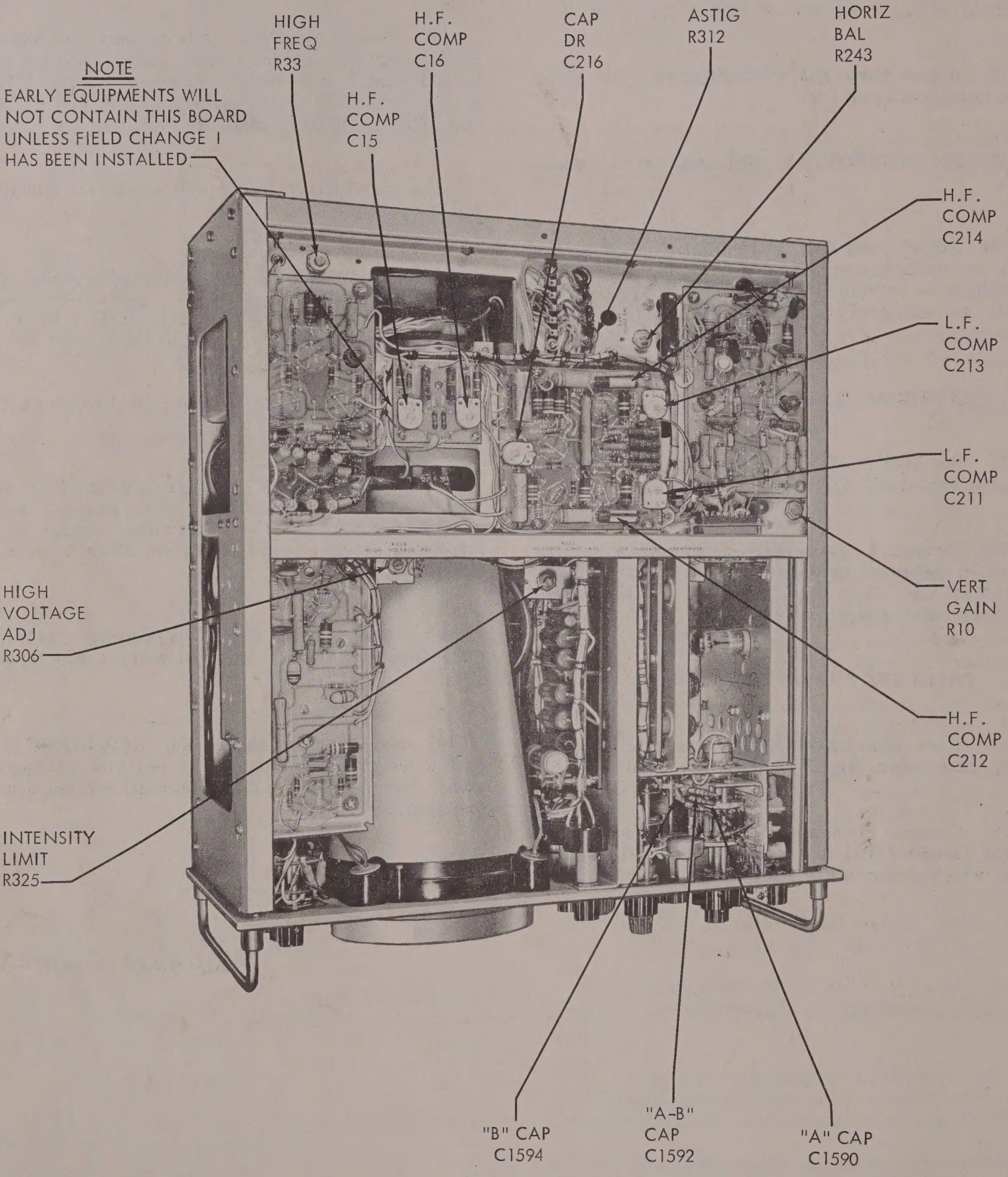

NOTE
EARLY EQUIPMENTS WILL NOT CONTAIN THIS BOARD UNLESS FIELD CHANGE I HAS BEEN INSTALLED
HIGH FREQ R33
H.F. COMP C15
H.F. COMP C16
CAP DR C216
ASTIG R312
HORIZ BAL R243
H.F. COMP C214
L.F. COMP C213
L.F. COMP C211
VERT GAIN R10
H.F. COMP C212
HIGH VOLTAGE ADJ R306
INTENSITY LIMIT R325
"B" CAP C1594
"A-B" CAP C1592
"A" CAP C1590

Figure 6-2 Location of Adjustments on Top Deck

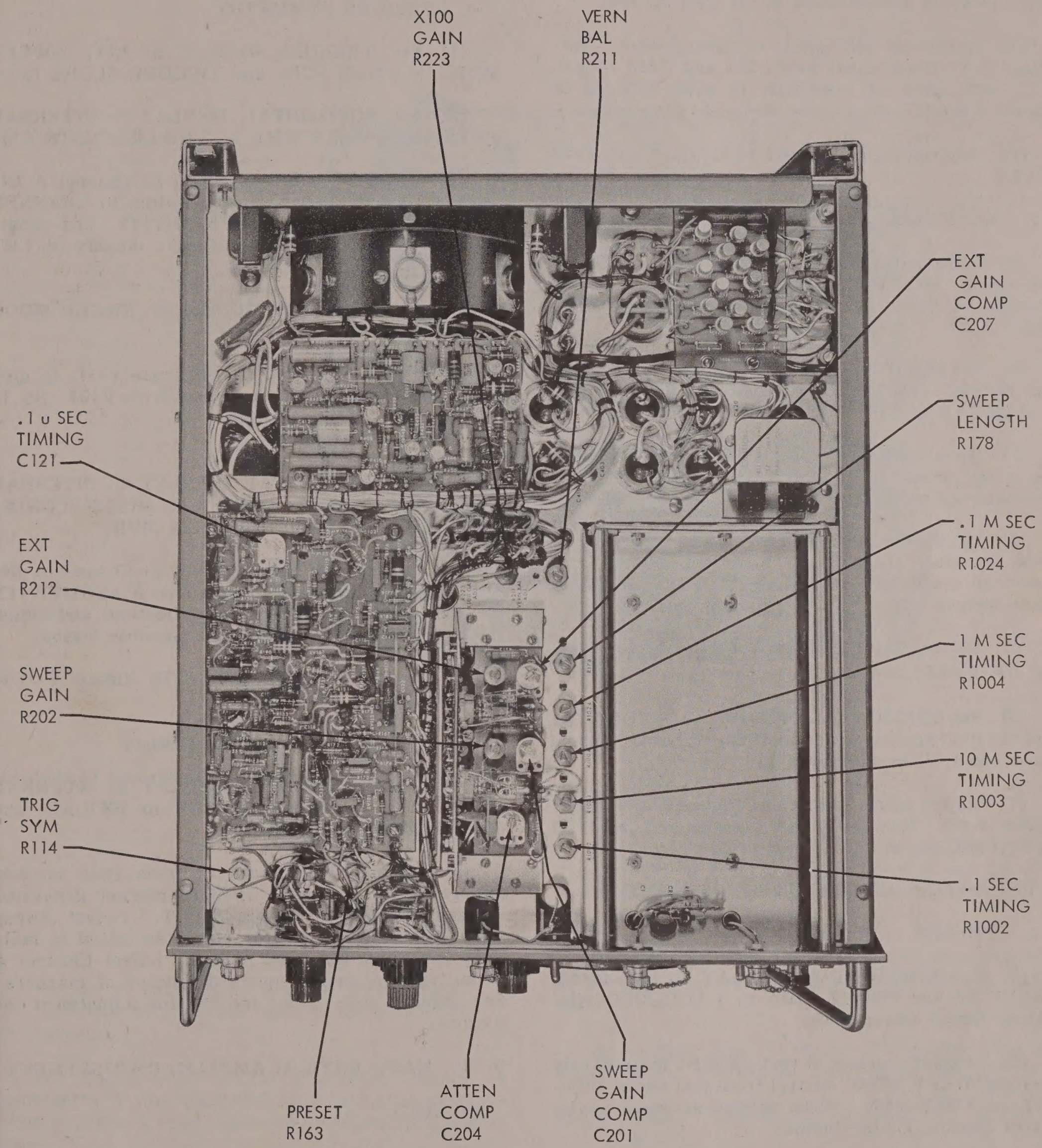

X100
GAIN
R223
VERN
BAL
R211
EXT
GAIN
COMP
C207
SWEEP
LENGTH
R178
.1 M SEC
TIMING
R1024
1 M SEC
TIMING
R1004
10 M SEC
TIMING
R1003
.1 SEC
TIMING
R1002
.1 u SEC
TIMING
C121
EXT
GAIN
R212
SWEEP
GAIN
R202
TRIG
SYM
R114
PRESET
R163
ATTEN
COMP
C204
SWEEP
GAIN
COMP
C201

Figure 6-3 Location of Adjustments on Bottom Deck

(11) Increase a square-wave amplitude to maximum and adjust HORIZONTAL POSITION until right side of square wave is just visible on left edge of CRT (most of square wave is off CRT to left).

(12) Overshoot will appear on square wave. Readjust L. F. Comp capacitors C211 and C213 (figure 6-2) until peak of overshoot is even with top of square wave.

(13) Reconnect green/white wire to circuit board A201.

f. EXTERNAL FREQUENCY COMPENSATION.

(1) Turn instrument off and connect jumper from test point D3 (100 volt terminal, figure 5-3) to junction of violet/orange lead and R143 on circuit board A101.

(2) Set HORIZONTAL DISPLAY to .5 VOLT/CM and SWEEP TIME to .1 MILLISECONDS/CM; connect SWEEP OUTPUT to Channel A INPUT.

(3) Turn instrument on and allow few minutes' warm up; connect 75-ohm output of square-wave generator to horizontal INPUT.

(4) Set Channel A SENSITIVITY to make sweep (now vertical) about 5 cm long; set square-wave generator output to 4 kc and adjust its amplitude to make square wave about 5 cm wide on CRT.

(5) Adjust Ext Gain Comp C207, (figure 6-3) for flat square wave.

(6) Set HORIZONTAL DISPLAY to 1 VOLT/CM and readjust square-wave amplitude to make square wave about 5 cm wide on CRT.

(7) Adjust Atten Comp C204 (figure 6-3) for flat square wave. Remove jumper between test point D3 and circuit board A101.

6-10. SWEEP GENERATOR ADJUSTMENT.

a. PRESET.

(1) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X1 and SWEEP TIME to 1 MILLISECOND/CM or faster sweep time.

(2) Measure voltage at test point B1 while slowly rotating SWEEP MODE control from just out of PRESET to FREE RUN. Note voltage at which sweep starts (meter pointer jumps).

(3) Set SWEEP MODE to PRESET.

(4) Set Preset Adj, R163 (figure 6-3), fully counterclockwise; then rotate it clockwise to set voltage at test point B1 1.5 volts less negative than voltage noted in step (2) above.

b. TRIGGER SYMMETRY.

(1) Set TRIGGER SOURCE to INT, SWEEP MODE to FREE RUN, and TRIGGER SLOPE to +.

(2) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X1, SWEEP TIME to .5 MILLISECONDS/CM.

(3) Connect calibrator output to Channel A INPUT; set Vertical Presentation switch to CHANNEL A; and set CALIBRATOR, SENSITIVITY, and sensitivity VERNIER controls to make display on CRT just 0.2 cm high.

(4) Ground pin 7 of V101 and set SWEEP MODE to PRESET.

(5) Adjust Trig Sym, R114 (figure 6-3), to give triggered sweep. Remove ground from V101, pin 7.

c. SWEEP LENGTH.

(1) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X1, SWEEP TIME to 20 MILLISECONDS/CM, and SWEEP MODE to FREE RUN.

(2) Connect calibrator output to Channel A INPUT; set CALIBRATOR and Channel A SENSITIVITY to give about 5 cm vertical deflection; and adjust TRIGGER LEVEL for shortest possible sweep.

(3) Adjust Sweep Length R178 (figure 6-3) to make sweep 11 cm long.

d. SWEEP TIME CALIBRATION.

(1) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X1, TRIGGER SOURCE to EXT AC, and SWEEP MODE to PRESET.

(2) Connect time markers from time marker generator to Channel A INPUT, marker generator trigger to trigger source INPUT. Select sweep time and marker generator output as listed in table 6-8, and adjust indicated control. Select Channel A sensitivity to give adequate deflection of markers. See figures 6-2, 6-3, and 6-4 for adjustment locations.

6-11. MAIN VERTICAL AMPLIFIER ADJUSTMENT.

a. GAIN.

(1) Connect sine-wave signal to Channel A INPUT.

(2) Measure signal amplitude at input to main vertical amplifier (R2 and R4).

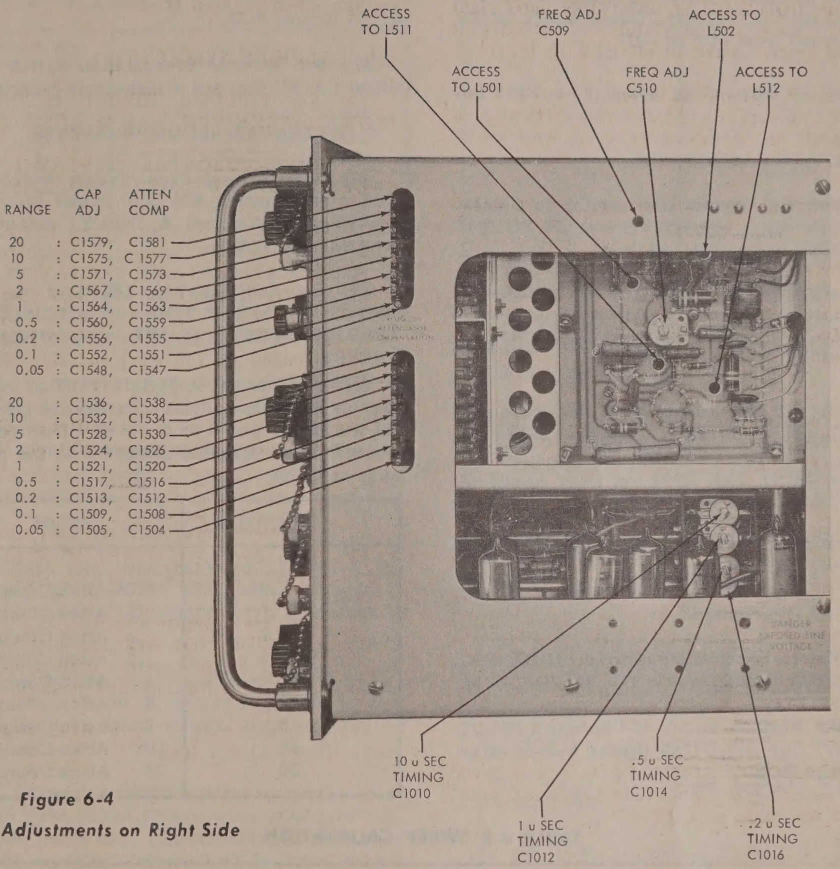

ACCESS TO L511
FREQ ADJ C509
ACCESS TO L502
ACCESS TO L501
FREQ ADJ C510
ACCESS TO L512
RANGE
CAP ADJ
ATTEN COMP
20 : C1579, C1581
10 : C1575, C 1577
5 : C1571, C1573
2 : C1567, C1569
1 : C1564, C1563
0.5 : C1560, C1559
0.2 : C1556, C1555
0.1 : C1552, C1551
0.05 : C1548, C1547
20 : C1536, C1538
10 : C1532, C1534
5 : C1528, C1530
2 : C1524, C1526
1 : C1521, C1520
0.5 : C1517, C1516
0.2 : C1513, C1512
0.1 : C1509, C1508
0.05 : C1505, C1504
PLUG ATTENUATOR COMPENSATION
DANGER EXPOSED LINE VOLTAGE
10 u SEC TIMING C1010
.5 u SEC TIMING C1014
1 u SEC TIMING C1012
.2 u SEC TIMING C1016

Figure 6-4

Location of Adjustments on Right Side

Note

Signal is balanced to ground. Therefore, both voltmeter leads must be isolated from ground.

(3) Adjust input signal amplitude, Channel A SENSITIVITY and VERNIER to give 1 volt peak-to-peak (0.354 volt rms) signal into main vertical amplifier.

(4) Adjust Vert Gain R10 (**figure 6-2**) to give 5 cm of vertical deflection on CRT.

b. HIGH FREQUENCY RESPONSE.

(1) Install special test plug-in unit (figure 6-1) in place of dual trace preamplifier.

(2) Apply output of square wave generator (Tektronix 107) to test plug-in input and set square-wave generator output to maximum amplitude and minimum frequency.

(3) Set TRIGGER SOURCE to INT; SWEEP MODE to PRESET, and SWEEP TIME to .5 MICROSECONDS/CM.

(4) Adjust High Freq Adj R33 (figure 6-2) for best square wave with overshoot less than 1%.

6-12. DUAL TRACE PREAMPLIFIER ADJUSTMENT.

a. BALANCE.

(1) Set Vertical Presentation switch to CHANNEL A and SWEEP MODE to FREE RUN.

(2) Vertically center sweep with Channel A VERTICAL POSITION control.

(3) Adjust Channel A BAL, R508 (on front panel) for no vertical shift of trace as Channel A POLARITY switch is switched from +UP to -UP.

(4) Repeat for channel B; adjust BAL R543 (on front panel).

b. SENSITIVITY CALIBRATION.

(1) Set Vertical Presentation switch to CHANNEL A; set Channel A SENSITIVITY to .02 VOLTS/CM and VERNIER to CALIBRATED.

(2) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X1, SWEEP TIME to 2 MILLISECONDS/CM, TRIGGER SOURCE to INT, and SWEEP MODE to PRESET.

(3) Connect 0.1 volt peak-to-peak sine-wave signal from voltmeter calibrator to Channel A INPUT.

(4) Adjust SENS CAL R504 (on front panel) for 5 cm of vertical deflection.

(5) Repeat for Channel B; adjust SENS CAL R546 (on front panel).

c. INPUT CAPACITANCE.

(1) Set Vertical Presentation switch to CHANNEL A and Channel A SENSITIVITY TO .02 VOLT/CM.

(2) Connect capacity meter to Channel A INPUT and adjust "A" Cap Adj C1590 (figure 6-2) to make input capacitance 29 pf.

(3) Repeat for Channel B; adjust "B" Cap Adj C1594 (figure 6-2).

(4) Set Vertical Presentation switch to A-B and adjust "A-B" Cap Adj to make input capacitance 29 pf.

d. ATTENUATOR COMPENSATION.

(1) Set Vertical Presentation switch to CHANNEL A and connect 600 ohm output of square-wave generator to Channel A INPUT; set square-wave frequency to 5 kc.

(2) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X1, SWEEP TIME to 5 MILLISECONDS/CM, TRIGGER SOURCE to INT, and SWEEP MODE to PRESET.

(3) Set Channel A SENSITIVITY as indicated below; in each case adjust square-wave generator output amplitude for 4 or 5 cm of deflection and adjust the indicated capacitor (figure 6-4) for best square wave on CRT:

Sensitivity	Adjust
.05	.05 Atten Comp C1547
.1	.1 Atten Comp C1551
.2	.2 Atten Comp C1555
.5	.5 Atten Comp C1559
1	1 Atten Comp C1563
2	2 Atten Comp C1569
5	5 Atten Comp C1573
10	10 Atten Comp C1577
20	20 Atten Comp C1581

TABLE 6-8 SWEEP CALIBRATION

Sweep Time	Marker	Adjust	Adjust for:
.1 msec/cm	100 μsec	.1 msec Timing R1024	1 marker/cm
1 msec/cm	1 msec	1 msec Timing R1004	1 marker/cm
10 msec/cm	10 msec	10 msec Timing R1003	1 marker/cm
.1 sec/cm	100 msec	.1 sec Timing R1002	1 marker/cm
.1 μsec/cm	10 mc (sine wave)	.1 μsec Timing C121 (on circuit board A101)	1 cycle/cm
.02 usec/cm (HORIZONTAL DISPLAY set to X5)	10 mc (sine wave)	H.F. Comp C212 and C214 (on circuit board A202)	Adjust to equal values to make signal symmetrical about center line of graticule.
.2 μsec/cm	5 mc (sine wave)	.2 μsec Timing C1016	1 cycle/cm
.5 μsec/cm	1 μsec	.5 μsec Timing C1014	1 marker/2 cm
1 μsec/cm	1 μsec	1 μsec Timing C1012	1 marker/cm
10 μsec/cm	10 μsec	10 μsec Timing C1010	1 marker/cm

(4) Repeat for Channel B:

Sensitivity	Adjust
.05	.05 Atten Comp C1504
.1	.1 Atten Comp C1508
.2	.2 Atten Comp C1512
.5	.5 Atten Comp C1516
1	1 Atten Comp C1520
2	2 Atten Comp C1526
5	5 Atten Comp C1530
10	10 Atten Comp C1534
20	20 Atten Comp C1538

e. ATTENUATOR INPUT CAPACITANCE.

(1) Set Vertical Presentation to CHANNEL A and Channel A SENSITIVITY to .02 VOLTS/CM.

(2) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X1, SWEEP TIME to 5 MILLISECONDS/CM, TRIGGER SOURCE to INT, and SWEEP MODE to PRESET.

(3) Connect test prod cable to Channel A INPUT, connect prod to 600 ohm output of square-wave generator, and set square-wave frequency to 5 kc.

(4) Adjust square-wave generator output amplitude to give 4 or 5 cm of deflection and adjust test prod capacitance to match it with input capacitance of Channel A.

(5) Set Channel A SENSITIVITY as indicated below; in each case adjust square-wave generator output amplitude for 4 or 5 cm of deflection and adjust the indicated capacitor (figure 6-4) for best square wave on CRT.

Sensitivity	Adjust
.05	.05 Cap Adj C1548
.1	.1 Cap Adj C1552
.2	.2 Cap Adj C1556
.5	.5 Cap Adj C1560
1	1 Cap Adj C1564
2	2 Cap Adj C1567
5	5 Cap Adj C1571
10	10 Cap Adj C1575
20	20 Cap Adj C1579

(6) Repeat for Channel B:

Sensitivity	Adjust
.05	.05 Cap Adj C1505
.1	.1 Cap Adj C1509
.2	.2 Cap Adj C1513
.5	.5 Cap Adj C1517
1	1 Cap Adj C1521
2	2 Cap Adj C1524
5	5 Cap Adj C1528
10	10 Cap Adj C1532
20	20 Cap Adj C1536

f. HIGH FREQUENCY RESPONSE.

(1) Set Vertical Presentation to CHANNEL A, Channel A SENSITIVITY to .02 VOLTS/CM, VERNIER to CALIBRATED.

(2) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X1, SWEEP TIME to .5 MICROSECONDS/CM, TRIGGER SOURCE to INT, and SWEEP MODE to PRESET.

(3) Connect square-wave generator (Tektronix 107) to Channel A INPUT; adjust square-wave frequency for 2 or 3 cycles on CRT and 4 or 5 cm of deflection.

(4) Adjust High Freq coils L501 and L502 (figure 6-4) for best square wave with no overshoot. Although coils are on left side of dual trace preamplifier, they are adjusted from right side through holes in circuit board A502.

(5) Repeat for Channel B; adjust High Freq coils L511 and L512.

g. SWITCHING MULTIVIBRATOR FREQUENCY.

(1) Set HORIZONTAL DISPLAY to INTERNAL SWEEP X1, SWEEP TIME to .1 MICROSECONDS/CM, VERNIER to CAL, TRIGGER SOURCE to INT, SWEEP MODE to FREE RUN, and INTENSITY MODULATION to EXTERNAL.

(2) Set Vertical Presentation to ALTERNATE and adjust VERTICAL POSITION controls for two traces about 4 cm apart.

(3) Set Vertical Presentation to CHOPPED and SWEEP MODE to PRESET.

(4) Adjust Freq Adj C509 and C510 (figure 6-4) for symmetrical square wave 10 cm long (neglect transients during switching).

6-13. REMOVAL OF COMPONENTS AND SUBASSEMBLIES.

a. INTRODUCTION. - The following paragraphs describe the procedures for removal and replacement of those subassemblies and components which are likely to require replacement or repair within the lifetime of the instrument and whose replacement is sufficiently complicated to require instructions. Also described are procedures for gaining access to certain subassemblies and components.

b. COMPONENT REPLACEMENT ON ETCHED CIRCUIT BOARDS. - The etched circuit boards used throughout the instrument are constructed with eyelets for component mounting; nevertheless; remove and replace components carefully. Use a small soldering iron, one with a maximum rating of 50 watts. Following removal of a component, clean circuit boards and eyelets of old solder. Tin the leads of new components before inserting them into a board, and cut the leads to such a length that they do not project below the circuit board and contact the chassis or other leads. Use a minimum of solder for the bond.

If a circuit board must be removed, first remove all electron tubes and tube clamps. When reinstalling the board, carefully align tube sockets and other protruding components with their respective chassis holes. Do not force the board into place by turning down on the mounting screws.

c. REPLACEMENT OF TRANSISTORS AND DIODES. - To solder and unsolder transistors and semiconductor diodes, place a heat sink on the lead of the component between its body and the point to which heat is applied. In addition, isolate the instrument from ground or ground the body of the soldering iron to prevent leakage voltage from damaging the component.

d. REMOVAL OF INSTRUMENT CABINET.

(1) Disconnect power cable and all cables and test prods from front panel; remove front cover if in place.

(2) Set instrument panel-down, resting it on draw handles.

(3) Remove four screws from rear of instrument and lift off cabinet.

e. REMOVAL OF CATHODE RAY TUBE.

WARNING

Wear plastic face mask or goggles and gloves when handling the cathode ray tube.

(1) Remove top access door from cabinet (see figure 6-5).

(2) Remove four mounting screws from bezel and remove bezel and graticule.

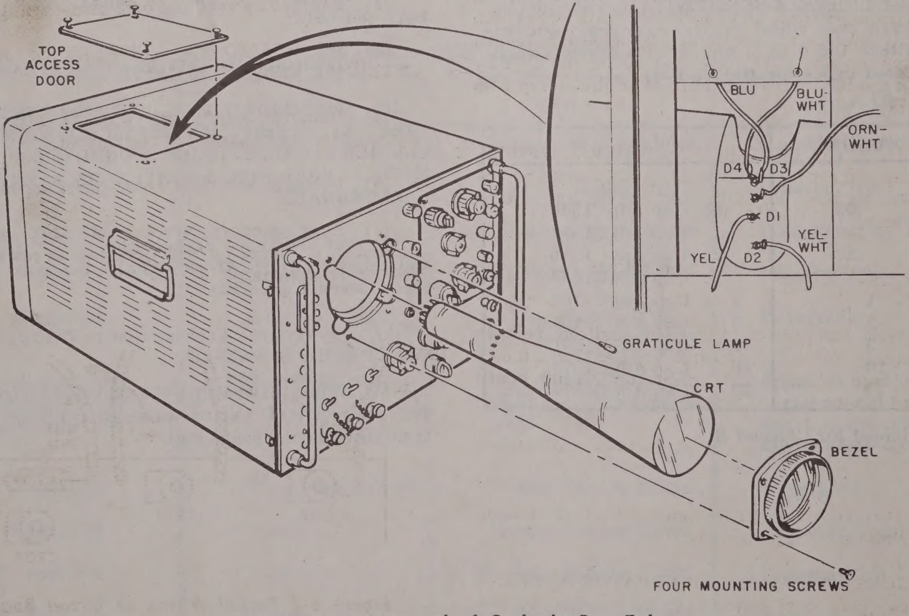


Figure 6-5 Removal of Cathode Ray Tube

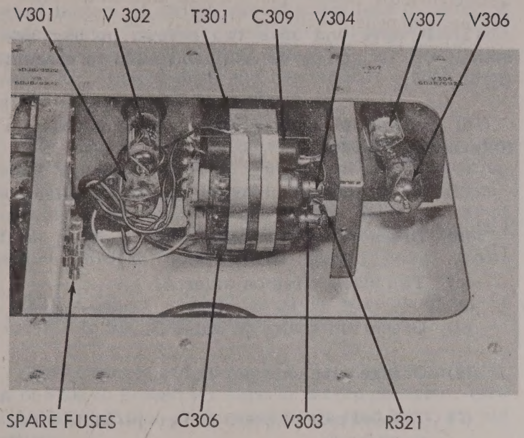


Figure 6-6 Access to High Voltage Power Supply

(3) Remove leads from neck of CRT and remove socket from CRT base.

(4) Loosen two screws holding clamp on CRT base. Do not remove screws or clamp.

(5) Slide CRT forward out of instrument.

To install CRT, reverse above procedure. When the CRT is installed, turn the instrument on, obtain a free-running sweep, and check sweep alignment with horizontal lines on the graticule. If necessary, loosen the clamp on the CRT base and rotate the CRT by means of the tab on the socket to align the sweep with the graticule.

f. REMOVAL OF HIGH VOLTAGE RECTIFIERS. High voltage rectifiers V303 and V304 cannot be removed without first partially removing the high voltage transformer.

(1) Remove cover from high voltage supply (see figure 6-6).

(2) With instrument in upright position, remove two mounting screws from high voltage transformer (through high voltage and calibrator circuit board A301) and loosen third mounting screw.

(3) Gently pry tubes out of sockets and remove caps.

(4) Turn transformer so tubes will clear housing and slide tubes out of assembly.

g. ACCESS TO SWEEP GENERATOR TUBES. - The sweep generator tubes may be reached by removing the dual trace preamplifier and the shield between the preamplifier and the sweep generator tubes. Two screws hold the shield in place. Return the shield before replacing the dual trace preamplifier.

h. ACCESS TO FAN, POWER SUPPLY TRANSISTORS. - The fan motor and certain power supply transistors are mounted on the fan shroud.

(1) Loosen mounting strap around body of fan motor. Reach screw of strap from right side of instrument.

(2) Remove eight screws holding fan shroud to rear chassis.

(3) Rotate assembly slightly to give transistors clearance and carefully remove assembly from instrument.

(4) To reinstall assembly, reverse above procedure. Position heat sink with two transistors at three o'clock (viewing instrument from rear), and position fan motor leads in notch of motor bracket.

i. REPLACEMENT OF HORIZONTAL DISPLAY SWITCH ASSEMBLY A200.

Note

> Read and understand each step before starting the step.

(1) Remove cabinet and both plug-in units.

(2) Set HORIZONTAL DISPLAY to X100 and EXTERNAL VERNIER to CAL.

(3) Remove both knobs with #8 Allen wrench mounted on rear chassis of instrument.

(4) Remove and save front-panel mounting nut.

(5) Rear support bracket of S202 is part of assembly. Remove and save two screws holding bracket to chassis.

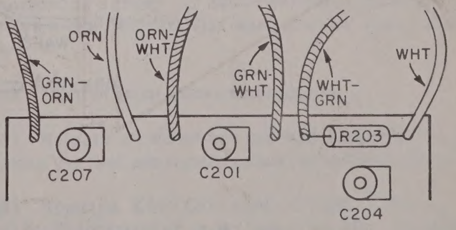


Figure 6-7 Partial Wiring of Circuit Board A201

(6) Remove and save shaft lock nut and mounting hardware for Vern Bal control R211 (figure 6-3).

(7) Remove and save shaft lock nut and mounting hardware for X100 Gain control R223 (figure 6-3).

(8) At insulated terminal of tie lug strip on mounting bracket of S202, disconnect white lead from center terminal of R211.

(9) At grounded terminal of tie lug strip, disconnect black wire from cable.

(10) Disconnect wht, wht/grn, orn/wht, orn, and grn/orn wires from circuit board A201. These wires are indicated in figure 6-7.

(11) At top of AC-DC switch S201, disconnect green wire from wafer A of S202.

(12) Remove bottom plate of dual trace preamplifier compartment.

(13) At top of wafer A on SWEEP TIME switch S1001, disconnect brown/white, red/white, orange/white, and green/white wires from top of wafer B of S202. **See figures 6-8 and 6-9.**

(14) Disconnect two grey wires at terminal on wafer C of S202 (47 ohm, 2 watt resistor also connected to this terminal).

(15) Remove and save two screws holding assembly of circuit boards A201 and A203 to chassis (figure 5-7).

(16) Cut off following wires as close as possible to terminals on S202.

- (a) Violet and violet/orange wires on wafer B.
- (b) Green wire on bottom of wafer A.
- (c) Two black wires on wafer A.
- (d) Green/white wire on wafer C.
- (e) Orange wire on wafer D.
- (f) Twisted pair of green and green/white wires on wafer E.
- (g) Orange/white wire on wafer E.
- (h) Yellow wire on rear of EXTERNAL VERNIER CAL switch S203.

(17) Remove and discard defective switch assembly.

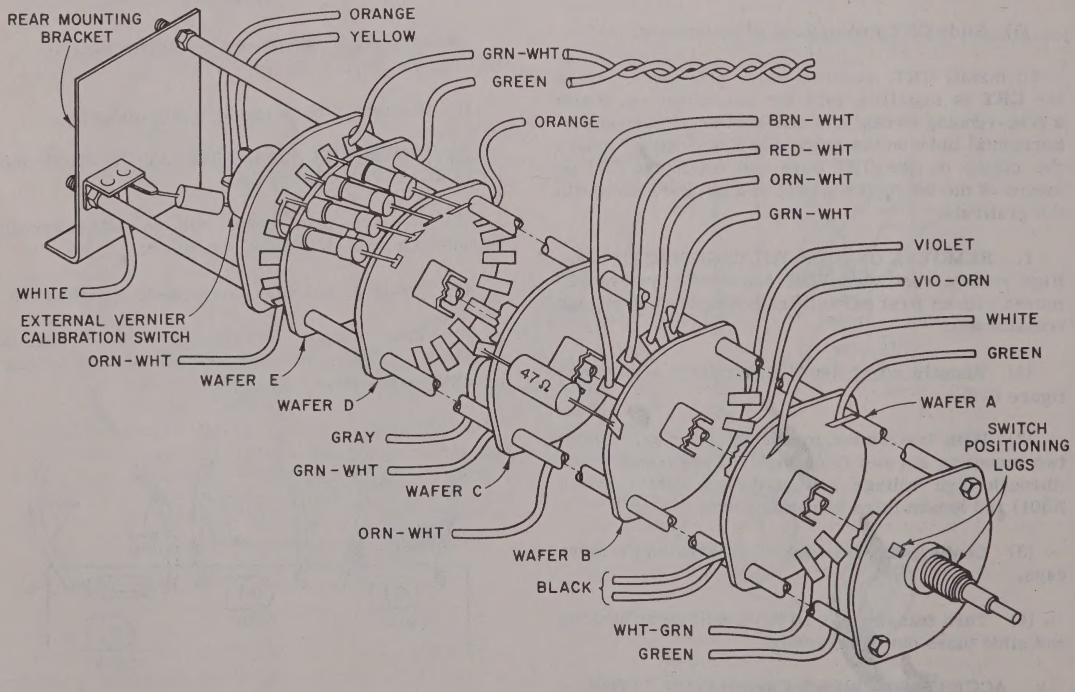

REAR MOUNTING BRACKET
ORANGE
YELLOW
GRN-WHT
GREEN
ORANGE
BRN-WHT
RED-WHT
ORN-WHT
GRN-WHT
VIOLET
VIO-ORN
WHITE
GREEN
WAFER A
SWITCH POSITIONING LUGS
WHITE
EXTERNAL VERNIER CALIBRATION SWITCH
ORN-WHT
WAFER E
WAFER D
47 Ω
GRAY
GRN-WHT
WAFER C
ORN-WHT
WAFER B
BLACK
WHT-GRN
GREEN

Figure 6-8 Horizontal Display Switch

(18) Dress all leads on replacement switch toward bottom of switch except green lead from top of wafer A; brown/white, red/white, orange/white, and green/white from top of wafer B; grey wire from wafer C; orange/white and twisted pair of green and green/white wires from wafer E.

(19) Insert replacement switch in instrument with shaft through front panel. Put on front-panel mounting nut and tighten finger tight. Be sure switch positioning lugs on front of switch engage holes in rear of front panel. Pass leads dressed toward bottom of switch through hole toward circuit board A201.

(20) Connect and solder green wire from top of wafer A to top of AC-DC switch S201.

(21) Connect and solder one black lead from wafer A of S202 to ground terminal on sweep generator circuit board A101. Disconnect black lead left from old switch.

(22) Connect and solder remaining black lead from wafer A of S202 to terminal on top of circuit board A203 in place of black lead from old switch.

(23) Connect and solder violet wire from wafer B of S202 to center terminal of R1002 (.1 Sec Timing) in place of violet wire from old switch.

(24) Connect and solder violet/orange wire from wafer B of S202 to one end of resistor R143 on sweep generator circuit board A101 in place of violet/orange wire from old switch. Dress new wire along same route as old wire.

(25) Dress brown/white, red/white, orange/white, and green/white wires from wafer B of S202 over to SWEEP TIME switch S1001 and connect and solder them to separate terminals on wafer A of S1001 as shown in figure 6-9.

(26) Orange wire from wafer D of S202 should be connected to R223. However, it is easier to connect old wire to terminal on wafer D of S202 in place of new orange wire supplied with replacement switch.

(27) Orange/white wire from wafer E of S202 should be connected to R223. However, it is easier to connect old wire to terminal on wafer E of S202 in place of orange/white wire supplied with replacement switch.

(28) Yellow wire from EXTERNAL VERNIER CAL switch S203 should be connected to circuit board A203. However, it is easier to connect old wire to S203 in place of yellow wire supplied with replacement switch.

(29) Route new twisted pair of green and green/white wires from wafer E of S202 along same path wires from original switch and connect new wires in place of old ones. Connect green wire to junction of R224 and C211 on horizontal amplifier circuit board A202; connect green/white wire to junction of R259 and C213 on same board.

(30) Connect and solder grey wire from Vern Bal control R211 and grey wire from SCALE LIGHT control R1025 to terminal on wafer C of S202 to which grey wire and 47 ohm, 2 watt resistor are connected. Remove and discard grey wire supplied on switch.

(31), Green/white wire from wafer C of S202 should be connected to circuit board A203. However, it is easier to connect old green/white wire on wafer C of S202 in place of wire supplied with replacement switch.

(32) Remove mounting nut for S202 and slide back to gain access to bottom terminal on wafer A to which green wire is attached.

(33) Replace green wire from bottom of wafer A of S202 with green wire from circuit board A203.

(34) Slide switch forward through panel and engage switch position lugs in holes on rear side of front panel. Replace front-panel mounting nut and tighten finger tight.

(35) All wires from S202 except following five wires should be connected by this step:

(a) Orange wire from EXTERNAL VERNIER CAL switch S203.

(b) Green/orange and orange/white wires from wafer C.

(c) White and white/green wires from wafer A.

(36) Dress five wires identified above so they are in sequence for connecting to circuit board A201 (see figure 6-7).

(37) Remount assembly of circuit boards A201 and A203 on chassis. Use two 6-32 x 3/4 inch mounting screws and #6 internal tooth lock washer under each screw head.

(38) Refer to figure 6-7 and connect five wires identified in step 35 to circuit board A201.

(39) Replace but do not tighten two 6-32 x 3/8 inch mounting screws for S202 rear mounting bracket. Place #6 x 3/8 inch o.d. flat washer under each screw head.

(40) Tighten front-panel mounting nut.

(41) Be sure no wires are pinched under S202 rear mounting bracket and tighten mounting bracket screws.

(42) Remount X100 Gain control R223. Place internal tooth lockwasher under mounting nut. Be sure locating lug is in corresponding chassis hole before

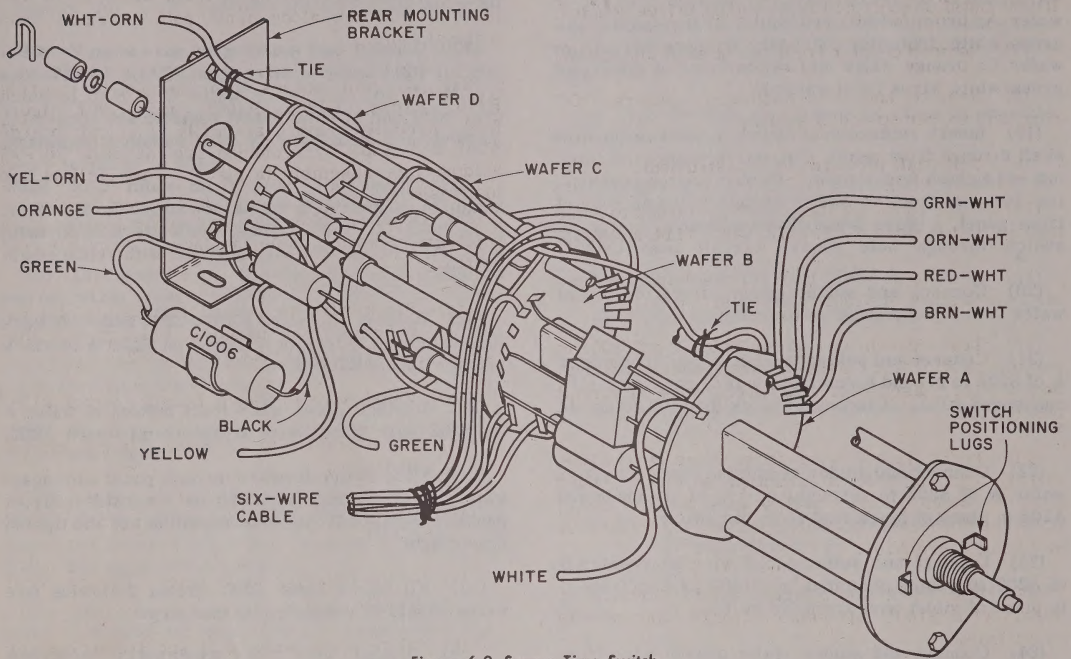

WHT-ORN
REAR MOUNTING BRACKET
TIE
WAFER D
YEL-ORN
ORANGE
WAFER C
GREEN
GRN-WHT
ORN-WHT
WAFER B
RED-WHT
TIE
BRN-WHT
C1006
WAFER A
SWITCH POSITIONING LUGS
BLACK
YELLOW
GREEN
SIX-WIRE CABLE
WHITE

Figure 6-9 Sweep Time Switch

tightening mounting nut. Be sure no wires are pinched under control.

(43) Remount Vern Bal control R211. Follow same procedure given for R223 above.

(44) Replace shaft locknuts on R223 and R211.

(45) Connect and solder white wire from center terminal of Vern Bal control R211 to insulated terminal of tie lug strip on rear mounting bracket of S202.

(46) Connect and solder black wire from cable to grounded terminal of tie lug strip on rear mounting bracket of S202.

(47) Replace black knob on HORIZONTAL DISPLAY switch S202. Be sure switch is rotated fully clockwise. Tighten both set screws with knob pointer in X100 position.

(48) Replace red knob on EXTERNAL VERNIER control shaft. Rotate shaft fully clockwise to CAL position and tighten knob so pointer points to CAL.

(49) Replace bottom plate of dual trace preamplifier compartment. Use two 6-32 x 3/8 inch machine screws with lockwashers.

(50) Switch replacement is complete. Before putting instrument back into service, check Horizontal Amplifier Adjustment (paragraph 6-9).

j. REPLACEMENT OF SWEEP TIME SWITCH ASSEMBLY A1000.

Note

Read and understand each step before starting the step.

(1) Remove cabinet and both plug-in units.

(2) Remove knobs from SWEEP TIME switch and VERNIER control. Use #8 Allen wrench mounted on rear chassis of instrument.

(3) Remove and save front-panel mounting nut.

(4) Remove bottom plate of dual trace preamplifier compartment. Plate is held in place by two screws.

(5) Examine coupling at inner end of center shaft of S1001. Small hairpin-shaped coupler connects shaft to R1009.

(6) Loosen but do not remove mounting nut of R1009 and slide control back far enough to free coupler.

(7) Remove coupler from end of shaft and save it.

(8) Remove and save washer(s), spacers, "O" ring, and spacer on end of shaft.

(9) Pull shaft forward out of instrument.

(10) Mark tubes so they can be returned to same sockets and remove V101, V113, V107, V114, and V115.

(11) Remove and save both screws holding mounting rear bracket of S1001 to chassis.

(12) Trace green wire from wafer C of S1001 to junction of R151 and CR104 on sweep generator circuit board A101; disconnect this green wire at circuit board A101.

(13) Trace yellow wire from wafer D on S1001 through chassis hole to terminal on circuit board A101 to which another yellow wire and one end of R179 are connected; disonnect yellow wire from S1001 at circuit board A101.

(14) Disconnect white/orange wire at terminal on wafer A of S1001 and remove ties holding wire to S1001 frame.

(15) Disonnect brown/white, red/white, orange/white, and green/white wires at their respective terminals on wafer A of S1001.

(16) At socket terminal for SWEEP UNCAL lamp DS1001, disconnect white wire from wafer A of S1001.

(17) Disconnect green wire from wafer D of S1001 at rear terminal of 1.0 mfd 200 volt capacitor C1006.

(18) Disconnect black wire from wafer D of S1001 at front terminal of C1006.

(19) Orange and yellow/orange wires connect two terminals of wafer B of S1001 to two terminals on CAL switch S1002 on rear of VERNIER control R1009. These wires will be used for connections to replacement switch. Cut both wires at terminals on wafer B of S1001.

(20) Cut six-wire cable connecting to wafer B of S1001 and remove defective switch.

(21) Pull cable cut in step 20 into compartment for Auxiliary plug-in.

(22) Remove center shaft from replacement switch and place switch in instrument. Pass yellow wire (disconnected in step 13) from wafer D of S1001 through chassis hole with other wires when inserting switch.

(23) Route six-wire cable from wafer B of replacement switch along same path as cable from original switch.

(24) To gain access to terminals to controls R178, R1024, R1004, R1003, and R1002 (figure 6-3), partially remove assembly of circuit boards A201 and A203 by removing two mounting screws holding this assembly in place. Save screws and lockwashers.

(25) Observe color code and connect wires from replacement switch cable in place of wires from old switch:

(a) Black wire to ground terminal of tie lug strip on rear mounting bracket of HORIZONTAL DISPLAY switch S202.

(b) Violet wire to Sweep Length control R178.

(c) White/orange to .1 msec Timing control R1024.

(d) White/black wire to 1 msec Timing control R1004.

(e) White/red wire to 10 msec Timing control R1003.

(f) White/green wire to .1 sec Timing control R1002.

(26) Remount assembly of circuit boards A201 and A203. Use 6-32 x 3/4 inch screws and #6 internal tooth lockwashers.

(27) Route orange and yellow/orange wires (disconnected in step 19) through S1001 switch wafers to wafer B in place of wires with corresponding colors supplied on replacement switch. Connect routed wires to wafer B terminals in place of supplied wires.

(28) Connect black wire from wafer D of S1001 to front terminal of 1.0 mfd 200 volt capacitor C1006. See figure 6-9.

(29) Connect green wire from wafer D of S1001 to rear terminal of C1006.

(30) Connect white wire from wafer A of S1001 to vacant socket terminal of SWEEP UNCAL lamp DS1001.

(31) Connect green/white, orange/white, red/white, and brown/white wires from HORIZONTAL DISPLAY switch S202 to their respective terminals on wafer A of S1001. See figure 6-9 for proper locations.

(32) Connect white/orange wire (disconnected in step 14) from circuit board A302 to vacant terminal on rear side of wafer A of S1001. A 3.3 megohm resistor is connected to adjacent terminal.

(33) Tie white/orange wire to frame of S1001 at wafers A and D.

(34) Connect yellow wire from wafer D of S1001 to terminal on circuit board A101 to which another yellow wire and R179 are connected.

(35) Dress green wire from wafer C of S1001 through chassis hole and hole in circuit board A101. Connect green wire to junction of R151 and CR104 on circuit board A101.

(36) Dress green wire along chassis and between tubes V114 and V115. Leave no slack at board A101.

(37) Replace but do not tighten two 6-32 x 3/8 inch and #6 x 3/8 inch o.d. flat washers for rear mounting bracket of S1001. Be sure switch positioning lugs on front of switch engage holes in rear of front panel.

(38) Replace and tighten front-panel mounting nut; then tighten two rear mounting screws. Be sure no wires are pinched under mounting bracket.

(39) Insert new shaft through center of S1001 and replace spacer, ''O'' ring, and spacer on inner end of center shaft.

(40) Replace washer(s) removed from shaft in step 8 and replace hairpin coupler on end of shaft.

(41) Engage coupler in slot on end of shaft of VERNIER control R1009.

(42) Tighten mounting nut for R1009.

(43) Center shaft of S1001 should have approximately 1/32 inch end play and couplet must fully engage slot in shaft of R1009. Washer(s) placed on center shaft in step 40 determine end play and can be varied in number to adjust end play.

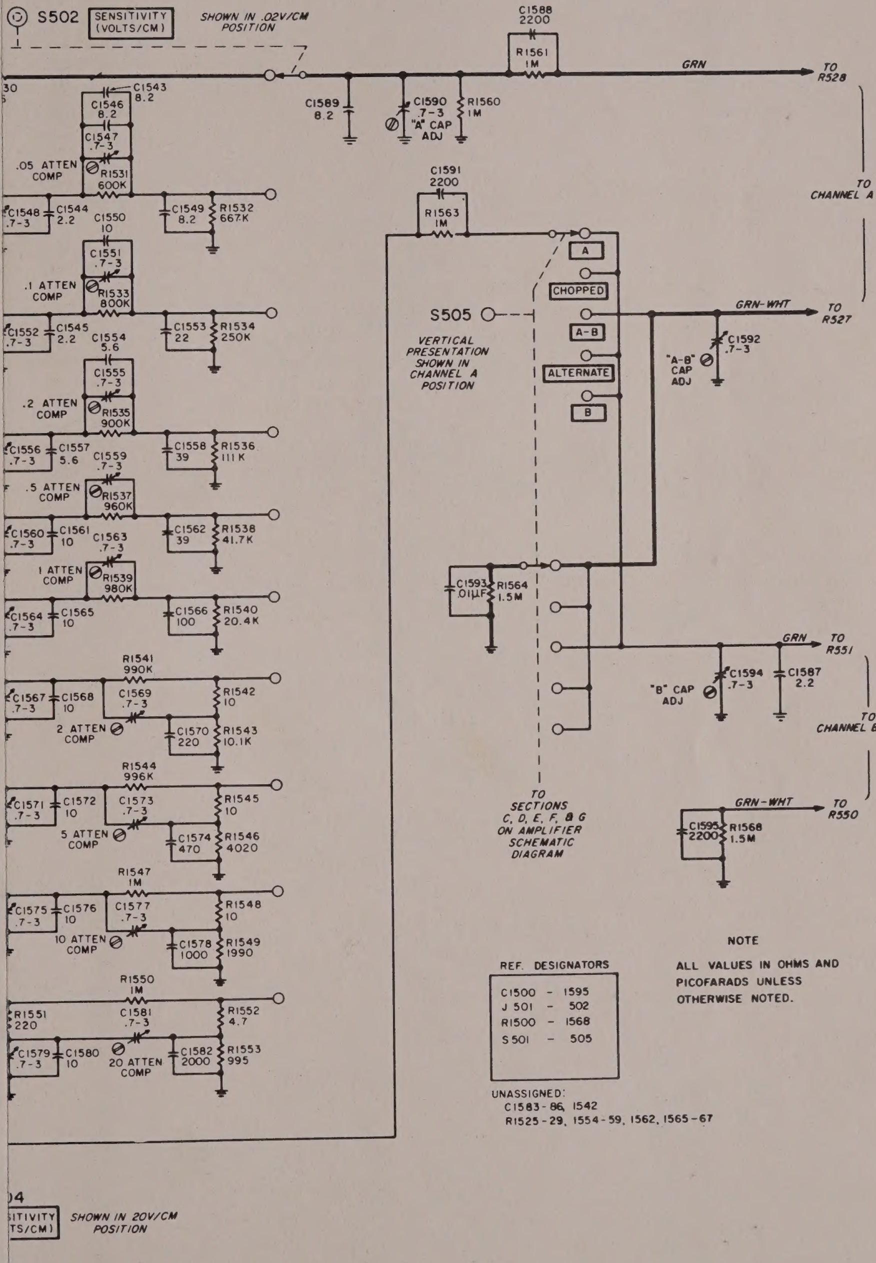
(44) Replace tubes V115, V114, V107, V113, and V101.

(45) Replace bottom plate of dual trace preamplifier compartment. Use two 6-32 x 3/8 inch machine screws with lockwashers.

(46) Replace black knob on SWEEP TIME switch. Be sure switch is rotated fully clockwise and tighten both set screws with knob pointer in .1 MICROSECONDS/CM position.

(47) Replace red knob on VERNIER control shaft. Rotate shaft fully clockwise to CAL and tighten both set screws so pointer points to CAL.

(48) Switch replacement is complete. Before putting instrument back into service, check sweep calibration, paragraph 6-10 d.


S502
SENSITIVITY (VOLTS/CM)
SHOWN IN .02V/CM POSITION
C1588 2200
R1561 1M
GRN
TO R528
C1589 8.2
C1590 .7-3
"A" CAP ADJ
R1560 1M
C1543 8.2
C1546 8.2
C1547 .7-3
.05 ATTEN COMP
R1531 600K
C1548 .7-3
C1544 2.2
C1550 10
C1549 8.2
R1532 667K
C1551 .7-3
.1 ATTEN COMP
R1533 800K
C1552 .7-3
C1545 2.2
C1554 5.6
C1553 22
R1534 250K
C1555 .7-3
.2 ATTEN COMP
R1535 900K
C1556 .7-3
C1557 5.6
C1559 .7-3
C1558 39
R1536 111K
.5 ATTEN COMP
R1537 960K
C1560 .7-3
C1561 10
C1563 .7-3
C1562 39
R1538 41.7K
1 ATTEN COMP
R1539 980K
C1564 .7-3
C1565 10
C1566 100
R1540 20.4K
R1541 990K
C1567 .7-3
C1568 10
C1569 .7-3
R1542 10
2 ATTEN COMP
C1570 220
R1543 10.1K
R1544 996K
C1571 .7-3
C1572 10
C1573 .7-3
R1545 10
5 ATTEN COMP
C1574 470
R1546 4020
R1547 1M
C1575 .7-3
C1576 10
C1577 .7-3
R1548 10
10 ATTEN COMP
C1578 1000
R1549 1990
R1550 1M
R1551 220
C1581 .7-3
R1552 4.7
C1579 .7-3
C1580 10
20 ATTEN COMP
C1582 2000
R1553 995
C1591 2200
R1563 1M
TO CHANNEL A
A
CHOPPED
S505
GRN-WHT
TO R527
A-B
C1592 .7-3
"A-B" CAP ADJ
VERTICAL PRESENTATION SHOWN IN CHANNEL A POSITION
ALTERNATE
B
C1593 .01μF
R1564 1.5M
GRN
TO R551
C1594 .7-3
C1587 2.2
"B" CAP ADJ
TO CHANNEL B
TO SECTIONS C, D, E, F, & G ON AMPLIFIER SCHEMATIC DIAGRAM
GRN-WHT
TO R550
C1595 2200
R1568 1.5M
04
SITIVITY TS/CM)
SHOWN IN 20V/CM POSITION

REF. DESIGNATORS

C1500 - 1595
J 501 - 502
R1500 - 1568
S 501 - 505

UNASSIGNED:
C1583 - 86, 1542
R1525 - 29, 1554 - 59, 1562, 1565 - 67

NOTE

ALL VALUES IN OHMS AND PICOFARADS UNLESS OTHERWISE NOTED.

ace Preamplifier Attenuator Schematic Diagram

(33) Tie white/orange wire to frame of S1001 at wafers A and D.

(34) Connect yellow wire from wafer D of S1001 to terminal on circuit board A101 to which another yellow wire and R179 are connected.

(35) Dress green wire from wafer C of S1001 through chassis hole and hole in circuit board A101. Connect green wire to junction of R151 and CR104 on circuit board A101.

(36) Dress green wire along chassis and between tubes V114 and V115. Leave no slack at board A101.

(37) Replace but do not tighten two 6-32 x 3/8 inch and #6 x 3/8 inch o.d. flat washers for rear mounting bracket of S1001. Be sure switch positioning lugs on front of switch engage holes in rear of front panel.

(38) Replace and tighten front-panel mounting nut; then tighten two rear mounting screws. Be sure no wires are pinched under mounting bracket.

(39) Insert new shaft through center of S1001 and replace spacer, "O" ring, and spacer on inner end of center shaft.

(40) Replace washer(s) removed from shaft in step 8 and replace hairpin coupler on end of shaft.

(41) Engage coupler in slot on end of shaft of VERNIER control R1009.

(42) Tighten mounting nut for R1009.

(43) Center shaft of S1001 should have approximately 1/32 inch end play and couplet must fully engage slot in shaft of R1009. Washer(s) placed on center shaft in step 40 determine end play and can be varied in number to adjust end play.

(44) Replace tubes V115, V114, V107, V113, and V101.

(45) Replace bottom plate of dual trace preamplifier compartment. Use two 6-32 x 3/8 inch machine screws with lockwashers.

(46) Replace black knob on SWEEP TIME switch. Be sure switch is rotated fully clockwise and tighten both set screws with knob pointer in .1 MICROSECONDS/CM position.

(47) Replace red knob on VERNIER control shaft. Rotate shaft fully clockwise to CAL and tighten both set screws so pointer points to CAL.

(48) Switch replacement is complete. Before putting instrument back into service, check sweep calibration, paragraph 6-10 d.

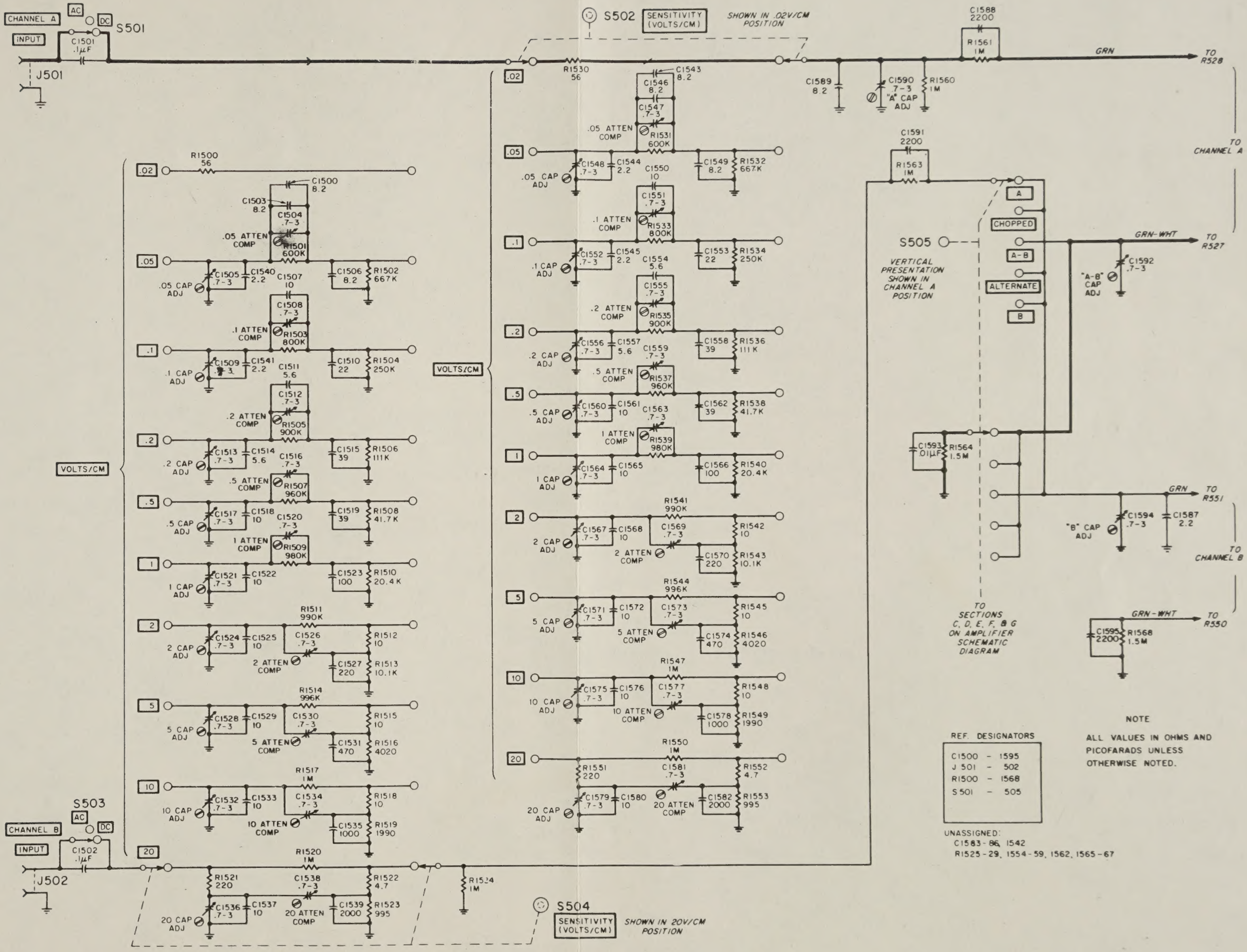
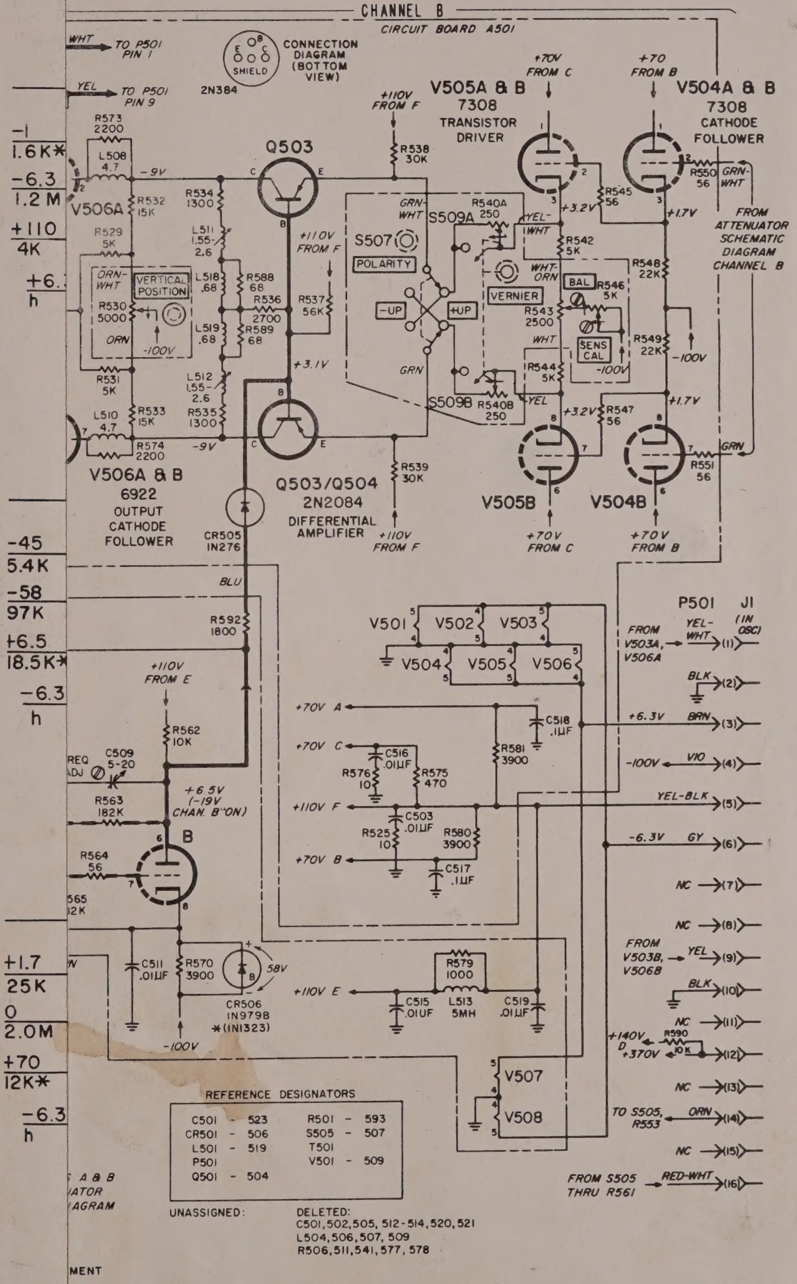
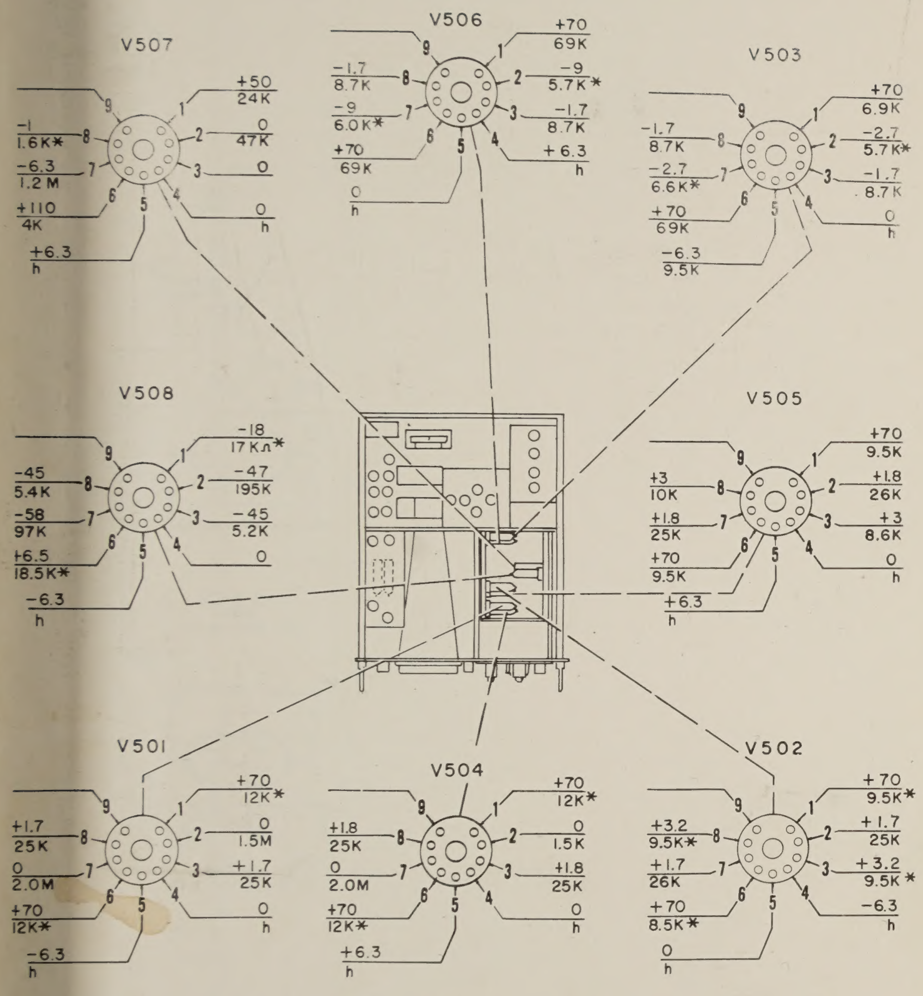

CHANNEL A
INPUT
AC
DC
S501
C1501 .1µF
J501
S502
SENSITIVITY (VOLTS/CM)
SHOWN IN .02V/CM POSITION
S503
CHANNEL B
INPUT
C1502 .1µF
J502
S504
SENSITIVITY (VOLTS/CM)
SHOWN IN 20V/CM POSITION
S505
VERTICAL PRESENTATION SHOWN IN CHANNEL A POSITION
A
CHOPPED
A-B
ALTERNATE
B
VOLTS/CM
.02
.05
.1
.2
.5
1
2
5
10
20
R1500 56
C1500 8.2
C1503 8.2
C1504 .7-3
.05 ATTEN COMP
R1501 600K
.05 CAP ADJ
C1505 .7-3
C1540 2.2
C1507 10
C1506 8.2
R1502 667K
C1508 .7-3
.1 ATTEN COMP
R1503 800K
.1 CAP ADJ
C1509 .7-3
C1541 2.2
C1511 5.6
C1510 22
R1504 250K
C1512 .7-3
.2 ATTEN COMP
R1505 900K
.2 CAP ADJ
C1513 .7-3
C1514 5.6
C1516 .7-3
C1515 39
R1506 111K
.5 ATTEN COMP
R1507 960K
.5 CAP ADJ
C1517 .7-3
C1518 10
C1520 .7-3
C1519 39
R1508 41.7K
1 ATTEN COMP
R1509 980K
1 CAP ADJ
C1521 .7-3
C1522 10
C1523 100
R1510 20.4K
R1511 990K
2 CAP ADJ
C1524 .7-3
C1525 10
C1526 .7-3
R1512 10
2 ATTEN COMP
C1527 220
R1513 10.1K
R1514 996K
5 CAP ADJ
C1528 .7-3
C1529 10
C1530 .7-3
R1515 10
5 ATTEN COMP
C1531 470
R1516 4020
R1517 1M
10 CAP ADJ
C1532 .7-3
C1533 10
C1534 .7-3
R1518 10
10 ATTEN COMP
C1535 1000
R1519 1990
R1520 1M
R1521 220
C1538 .7-3
R1522 4.7
20 CAP ADJ
C1536 .7-3
C1537 10
20 ATTEN COMP
C1539 2000
R1523 995
R1524 1M
R1530 56
C1543 8.2
C1546 8.2
C1547 .7-3
.05 ATTEN COMP
R1531 600K
.05 CAP ADJ
C1548 .7-3
C1544 2.2
C1550 10
C1549 8.2
R1532 667K
C1551 .7-3
.1 ATTEN COMP
R1533 800K
.1 CAP ADJ
C1552 .7-3
C1545 2.2
C1554 5.6
C1553 22
R1534 250K
C1555 .7-3
.2 ATTEN COMP
R1535 900K
.2 CAP ADJ
C1556 .7-3
C1557 5.6
C1559 .7-3
C1558 39
R1536 111K
.5 ATTEN COMP
R1537 960K
.5 CAP ADJ
C1560 .7-3
C1561 10
C1563 .7-3
C1562 39
R1538 41.7K
1 ATTEN COMP
R1539 980K
1 CAP ADJ
C1564 .7-3
C1565 10
C1566 100
R1540 20.4K
R1541 990K
2 CAP ADJ
C1567 .7-3
C1568 10
C1569 .7-3
R1542 10
2 ATTEN COMP
C1570 220
R1543 10.1K
R1544 996K
5 CAP ADJ
C1571 .7-3
C1572 10
C1573 .7-3
R1545 10
5 ATTEN COMP
C1574 470
R1546 4020
R1547 1M
10 CAP ADJ
C1575 .7-3
C1576 10
C1577 .7-3
R1548 10
10 ATTEN COMP
C1578 1000
R1549 1990
R1550 1M
R1551 220
C1581 .7-3
R1552 4.7
20 CAP ADJ
C1579 .7-3
C1580 10
20 ATTEN COMP
C1582 2000
R1553 995
C1588 2200
R1561 1M
GRN
TO R528
C1589 8.2
C1590 7-3
"A" CAP ADJ
R1560 1M
C1591 2200
R1563 1M
TO CHANNEL A
GRN-WHT
TO R527
C1592 .7-3
"A-B" CAP ADJ
C1593 .01µF
R1564 1.5M
GRN
TO R551
"B" CAP ADJ
C1594 .7-3
C1587 2.2
TO CHANNEL B
GRN-WHT
TO R550
C1595 2200
R1568 1.5M
TO SECTIONS C, D, E, F, & G ON AMPLIFIER SCHEMATIC DIAGRAM
REF. DESIGNATORS
C1500 - 1595
J501 - 502
R1500 - 1568
S501 - 505
UNASSIGNED:
C1583-86, 1542
R1525-29, 1554-59, 1562, 1565-67
NOTE
ALL VALUES IN OHMS AND PICOFARADS UNLESS OTHERWISE NOTED.

Figure 6-10 Dual Trace Preamplifier Attenuator Schematic Diagram


CHANNEL B
CIRCUIT BOARD A501
CONNECTION DIAGRAM (BOTTOM VIEW)
2N384
V505A & B
7308
TRANSISTOR DRIVER
V504A & B
7308
CATHODE FOLLOWER
Q503
Q503/Q504
2N2084
DIFFERENTIAL AMPLIFIER
V506A & B
6922
OUTPUT CATHODE FOLLOWER
VERTICAL POSITION
POLARITY
VERNIER
BAL
SENS CAL
FROM ATTENUATOR SCHEMATIC DIAGRAM CHANNEL B
CR505 IN276
CR506 IN979B *(IN1323)
+6.5V (-19V CHAN. B "ON")
P501 J1 (IN OSC)
FROM V503A, V506A
FROM V503B, V506B
TO S505, R553
FROM S505 THRU R561
REFERENCE DESIGNATORS
C501 - 523
CR501 - 506
L501 - 519
P501
Q501 - 504
R501 - 593
S505 - 507
T501
V501 - 509
UNASSIGNED:
DELETED:
C501, 502, 505, 512-514, 520, 521
L504, 506, 507, 509
R506, 511, 541, 577, 578

* SUPPLIED IN SOME EQUIPMENTS

fier Schematic Diagram

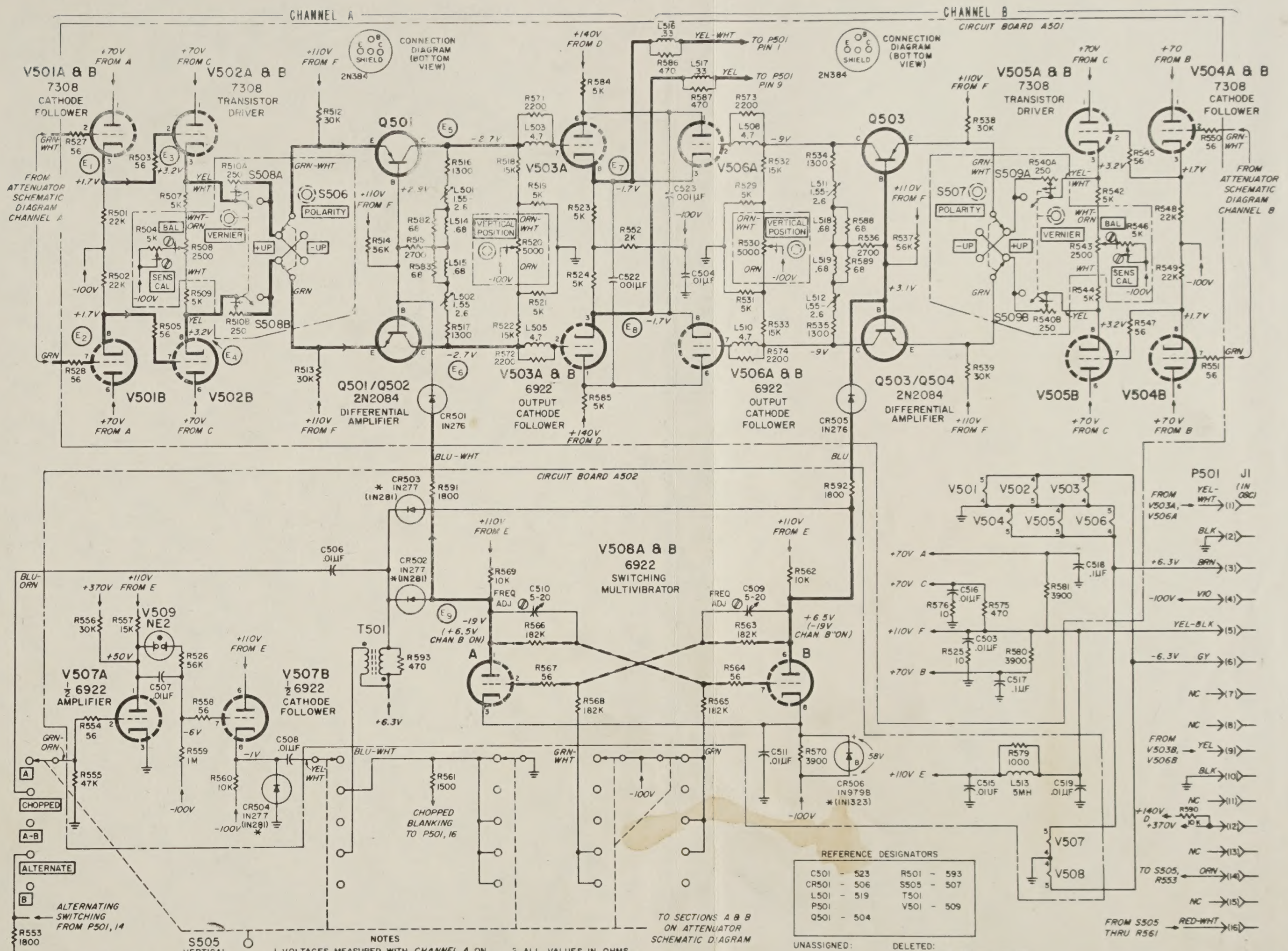

V507
+50 24K
0 47K
0
0 h
-1 1.6K*
-6.3 1.2M
+110 4K
+6.3 h
V506
+70 69K
-9 5.7K*
-1.7 8.7K
+6.3 h
-1.7 8.7K
-9 6.0K*
+70 69K
0 h
V503
+70 6.9K
-2.7 5.7K*
-1.7 8.7K
0 h
-1.7 8.7K
-2.7 6.6K*
+70 69K
-6.3 9.5K
V508
-18 17KΩ*
-47 195K
-45 5.2K
0
-45 5.4K
-58 97K
+6.5 18.5K*
-6.3 h
V505
+70 9.5K
+1.8 26K
+3 8.6K
0 h
+3 10K
+1.8 25K
+70 9.5K
+6.3 h
V501
+70 12K*
0 1.5M
+1.7 25K
0 h
+1.7 25K
0 2.0M
+70 12K*
-6.3 h
V504
+70 12K*
0 1.5K
+1.8 25K
0 h
+1.8 25K
0 2.0M
+70 12K*
+6.3 h
V502
+70 9.5K*
+1.7 25K
+3.2 9.5K*
-6.3 h
+3.2 9.5K*
+1.7 26K
+70 8.5K*
0 h

NOTES

1. MEASUREMENTS MADE WITH VERTICAL PRESENTATION SET TO CHANNEL A, SENSITIVITY SWITCHES SET TO .02V/CM, VERTICAL POSITION CONTROLS CENTERED.

2. RESISTANCES MEASURED WITH UNIT REMOVED FROM OSCILLOSCOPE.

* MEASUREMENT VARIES DUE TO SEMICONDUCTORS.


CHANNEL A
CHANNEL B
CIRCUIT BOARD A501
CIRCUIT BOARD A502
V501A & B 7308 CATHODE FOLLOWER
V502A & B 7308 TRANSISTOR DRIVER
V505A & B 7308 TRANSISTOR DRIVER
V504A & B 7308 CATHODE FOLLOWER
V501B
V502B
V505B
V504B
Q501
Q503
Q501/Q502 2N2084 DIFFERENTIAL AMPLIFIER
Q503/Q504 2N2084 DIFFERENTIAL AMPLIFIER
V503A
V506A
V503A & B 6922 OUTPUT CATHODE FOLLOWER
V506A & B 6922 OUTPUT CATHODE FOLLOWER
CONNECTION DIAGRAM (BOTTOM VIEW)
2N384
FROM ATTENUATOR SCHEMATIC DIAGRAM CHANNEL A
FROM ATTENUATOR SCHEMATIC DIAGRAM CHANNEL B
S506 POLARITY
S507 POLARITY
S508A
S508B
S509A
S509B
BAL
VERNIER
SENS CAL
VERTICAL POSITION
+UP
-UP
+70V FROM A
+70V FROM B
+70V FROM C
+110V FROM F
+140V FROM D
TO P501 PIN 1
TO P501 PIN 9
YEL-WHT
CR501 1N276
CR505 1N276
BLU-WHT
BLU
CR503 1N277 (1N281)
CR502 1N277 *(1N281)
R591 1800
R592 1800
V508A & B 6922 SWITCHING MULTIVIBRATOR
FREQ ADJ
C510 5-20
C509 5-20
A
B
V509 NE2
V507A ½ 6922 AMPLIFIER
V507B ½ 6922 CATHODE FOLLOWER
T501
CR504 1N277 (1N281)*
CR506 1N979B *(1N1323)
CHOPPED BLANKING TO P501, 16
A
CHOPPED
A-B
ALTERNATE
B
ALTERNATING SWITCHING FROM P501, 14
R553 1800
S505 VERTICAL PRESENTATION
TO SECTIONS A & B ON ATTENUATOR SCHEMATIC DIAGRAM
V501
V502
V503
V504
V505
V506
V507
V508
P501
J1 (IN OSC)
FROM V503A, V506A
FROM V503B, V506B
TO S505, R553
FROM S505 THRU R561
NC

NOTES

1. VOLTAGES MEASURED WITH *CHANNEL A* ON, *VERTICAL POSITION* CENTERED, AND *VERNIER* SET TO CAL.

2. ALL VALUES IN OHMS, MICROHENRIES, AND PICOFARADS UNLESS OTHERWISE NOTED.

3. ALL VOLTAGE AND RESISTANCE MEASUREMENT ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

REFERENCE DESIGNATORS

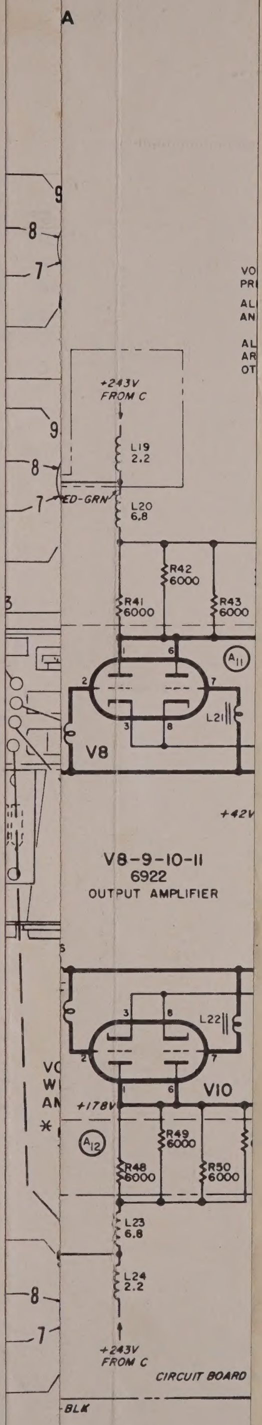
C501 - 523	R501 - 593
CR501 - 506	S505 - 507
L501 - 519	T501
P501	V501 - 509
Q501 - 504	

UNASSIGNED:

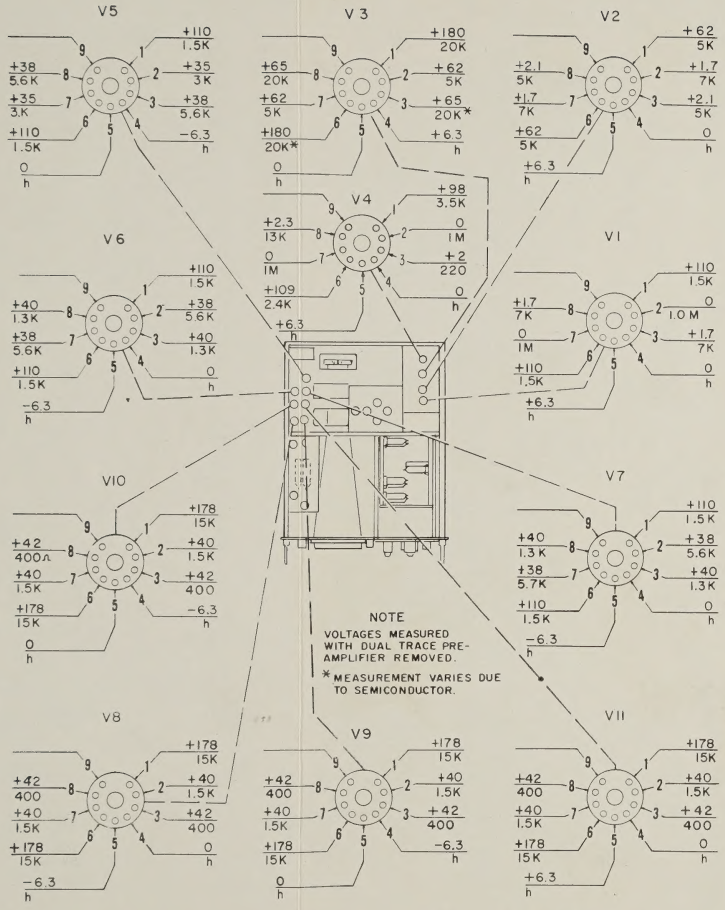
DELETED:
C501, 502, 505, 512-514, 520, 521
L504, 506, 507, 509
R506, 511, 541, 577, 578

* SUPPLIED IN SOME EQUIPMENT

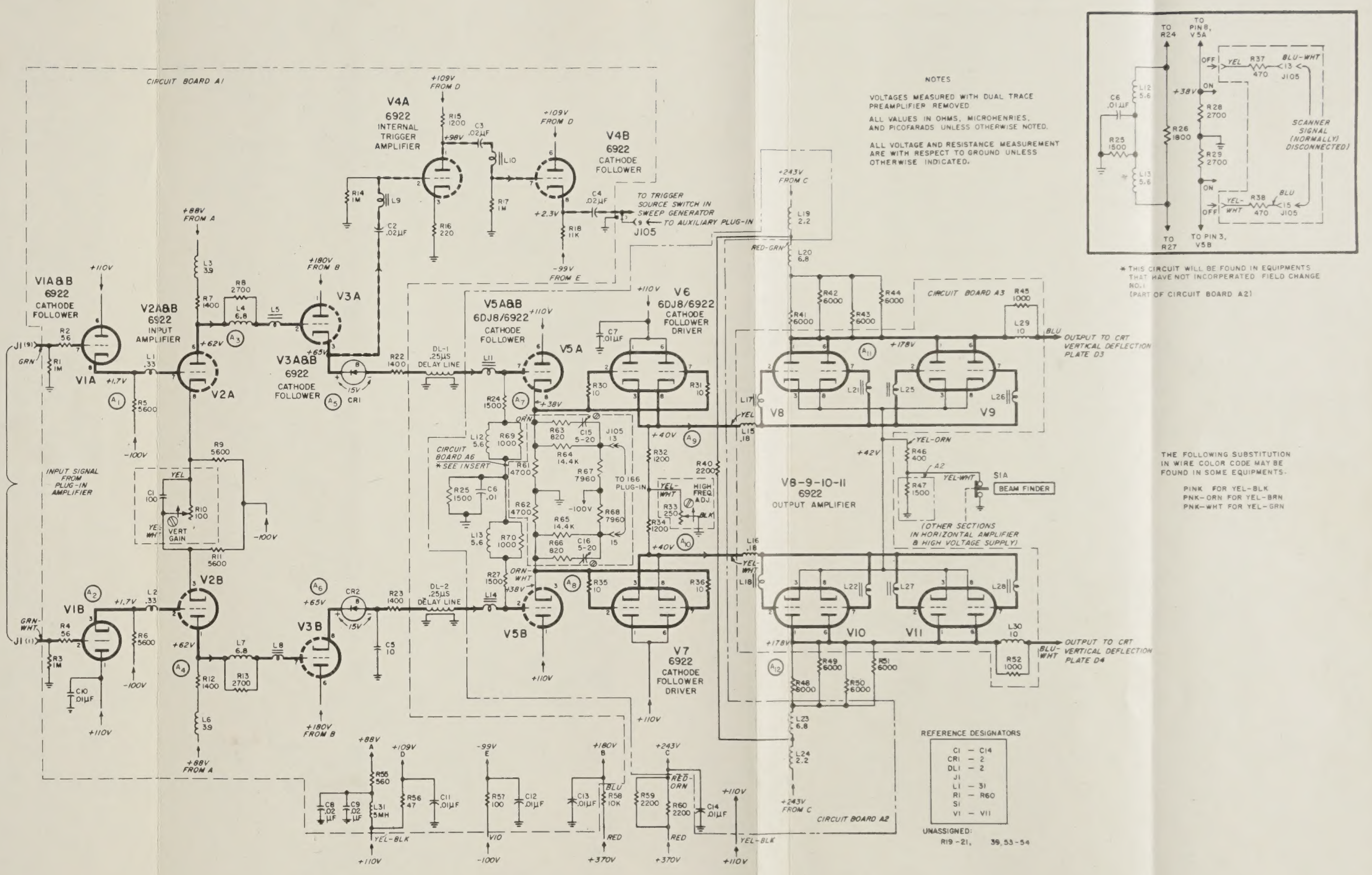
Figure 6-11 Dual Trace Preamplifier Amplifier Schematic Diagram


A
9
8
7
VO
PR
AL
AN
AL
AR
OT
+243V
FROM C
L19
2.2
ED-GRN
L20
6.8
R42
6000
R41
6000
R43
6000
A11
V8
L21
+42V
V8-9-10-11
6922
OUTPUT AMPLIFIER
L22
V10
+178V
VO
WI
AN
*
A12
R49
6000
R48
6000
R50
6000
L23
6.8
L24
2.2
+243V
FROM C
CIRCUIT BOARD
BLK

Diagram


V5
V3
V2
V4
V6
V1
V10
V7
V8
V9
V11

NOTE
VOLTAGES MEASURED WITH DUAL TRACE PRE-AMPLIFIER REMOVED.
* MEASUREMENT VARIES DUE TO SEMICONDUCTOR.


CIRCUIT BOARD A1
V4A 6922 INTERNAL TRIGGER AMPLIFIER
V4B 6922 CATHODE FOLLOWER
V1A&B 6922 CATHODE FOLLOWER
V2A&B 6922 INPUT AMPLIFIER
V3A&B 6922 CATHODE FOLLOWER
V5A&B 6DJ8/6922 CATHODE FOLLOWER
V6 6DJ8/6922 CATHODE FOLLOWER DRIVER
V7 6922 CATHODE FOLLOWER DRIVER
V8-9-10-11 6922 OUTPUT AMPLIFIER
CIRCUIT BOARD A3
CIRCUIT BOARD A2
CIRCUIT BOARD A6
INPUT SIGNAL FROM PLUG-IN AMPLIFIER
TO TRIGGER SOURCE SWITCH IN SWEEP GENERATOR
TO AUXILIARY PLUG-IN
OUTPUT TO CRT VERTICAL DEFLECTION PLATE D3
OUTPUT TO CRT VERTICAL DEFLECTION PLATE D4
BEAM FINDER
(OTHER SECTIONS IN HORIZONTAL AMPLIFIER & HIGH VOLTAGE SUPPLY)
SCANNER SIGNAL (NORMALLY DISCONNECTED)
DL-1 .25µS DELAY LINE
DL-2 .25µS DELAY LINE
VERT GAIN
HIGH FREQ ADJ

NOTES

VOLTAGES MEASURED WITH DUAL TRACE PREAMPLIFIER REMOVED

ALL VALUES IN OHMS, MICROHENRIES, AND PICOFARADS UNLESS OTHERWISE NOTED.

ALL VOLTAGE AND RESISTANCE MEASUREMENT ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

* THIS CIRCUIT WILL BE FOUND IN EQUIPMENTS THAT HAVE NOT INCORPERATED FIELD CHANGE NO. 1
(PART OF CIRCUIT BOARD A2)

THE FOLLOWING SUBSTITUTION IN WIRE COLOR CODE MAY BE FOUND IN SOME EQUIPMENTS.

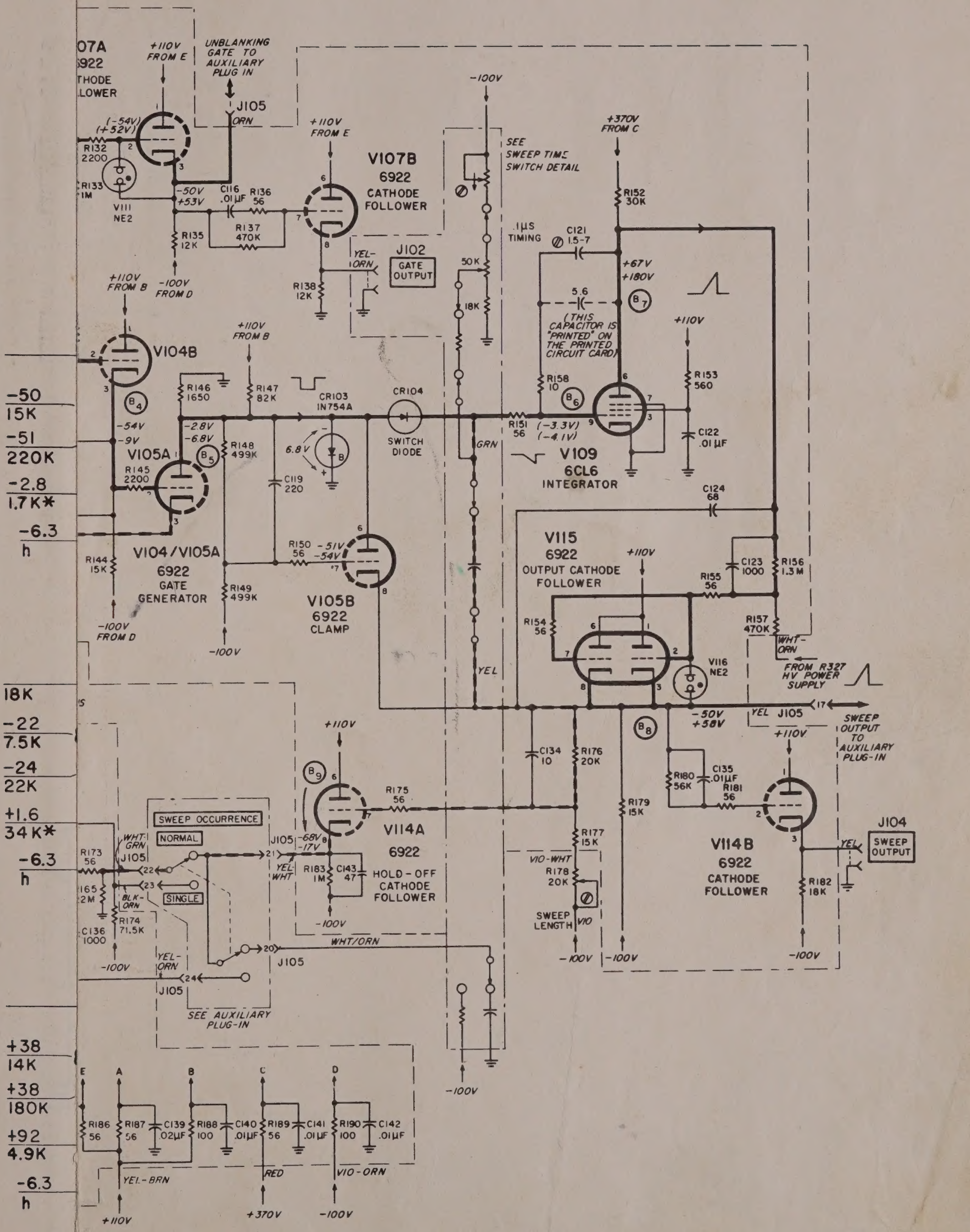
PINK FOR YEL-BLK
PNK-ORN FOR YEL-BRN
PNK-WHT FOR YEL-GRN

REFERENCE DESIGNATORS

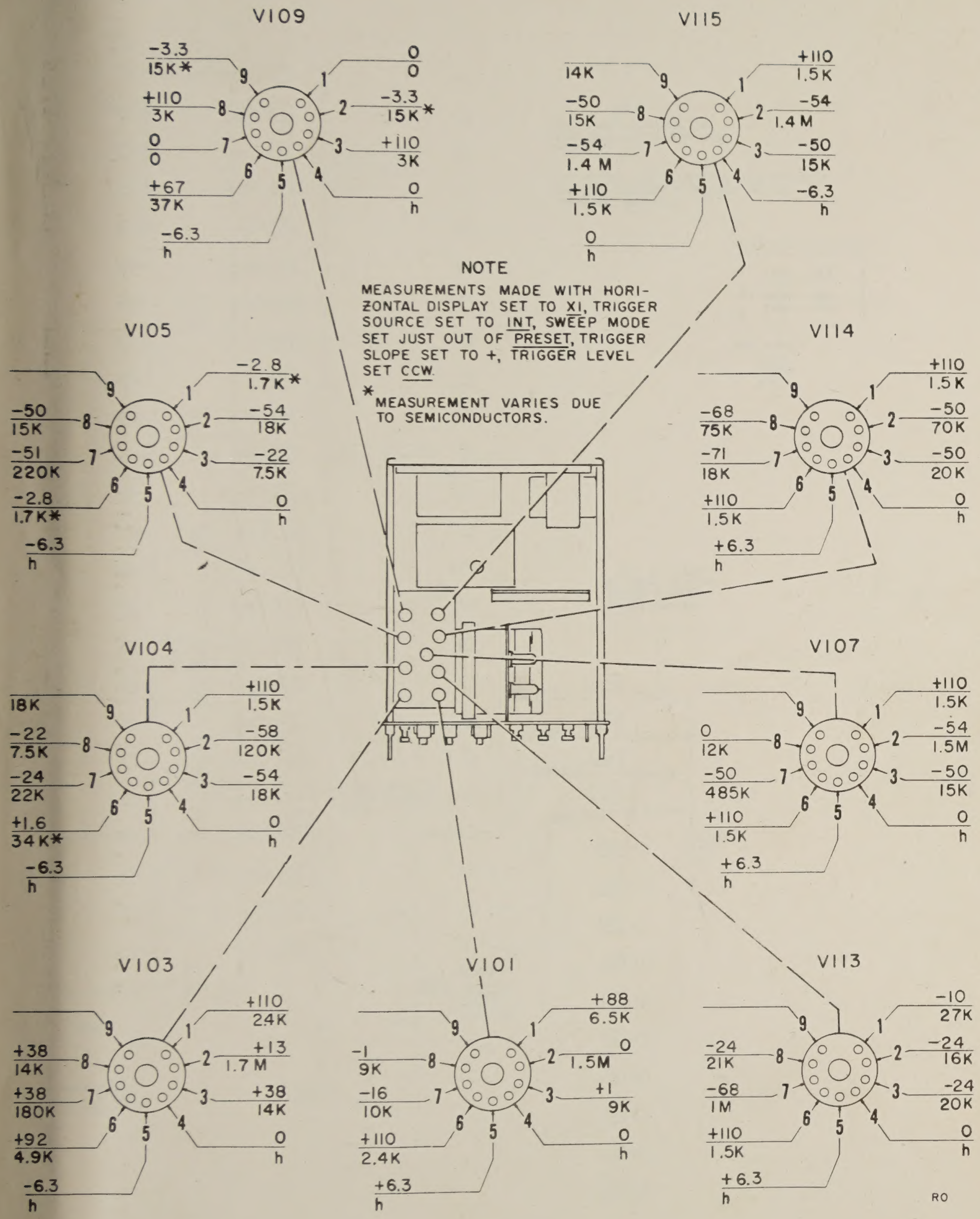
C1 — C14
CR1 — 2
DL1 — 2
J1
L1 — 31
R1 — R60
S1
V1 — V11

UNASSIGNED:
R19 - 21, 39, 53 - 54

Figure 6-12 Main Vertical Amplifier Schematic Diagram

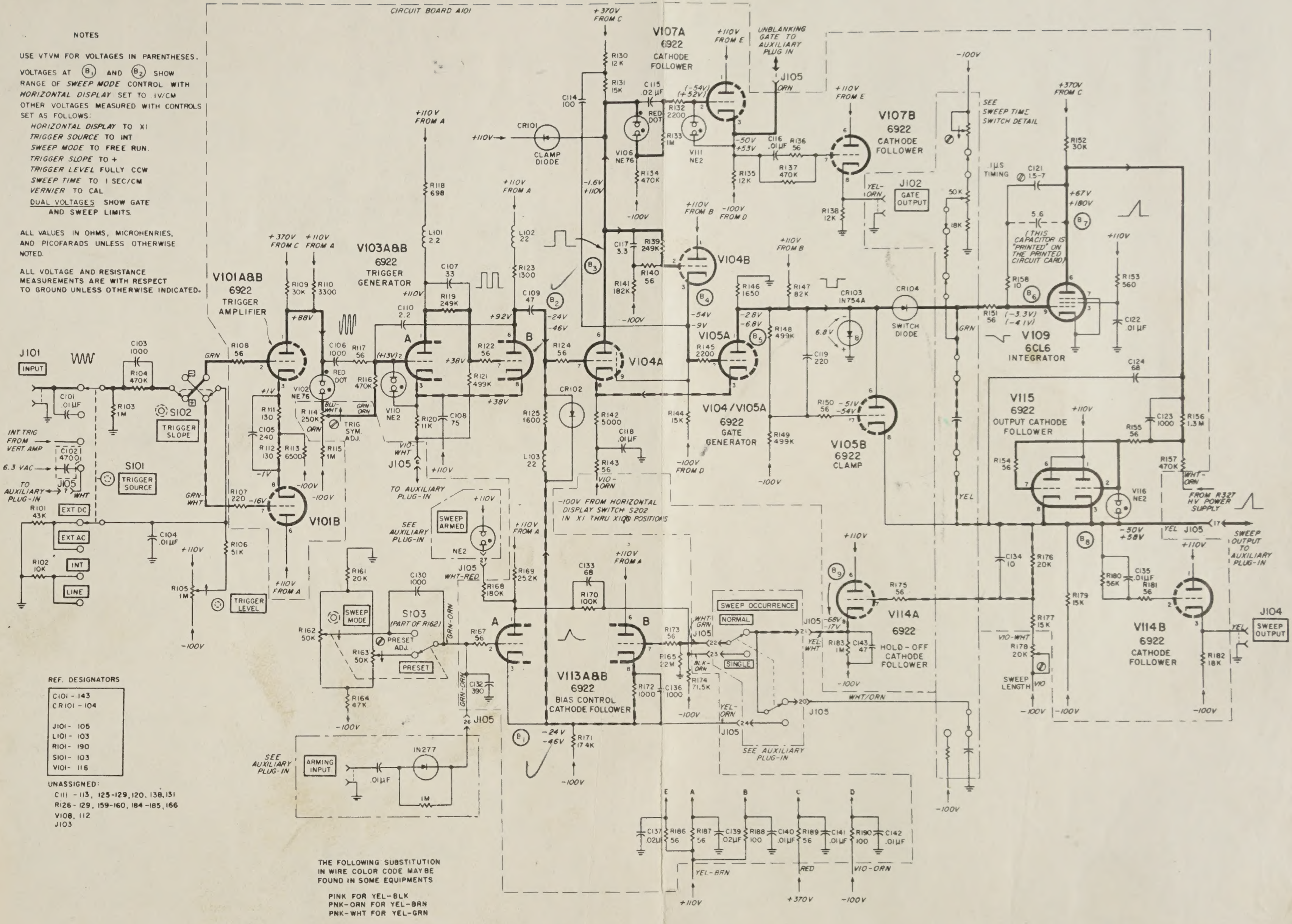

07A
922
THODE
LOWER
+110V FROM E
UNBLANKING GATE TO AUXILIARY PLUG IN
J105
ORN
(-54V)
(+52V)
R132 2200
R133 1M
V111 NE2
-50V
+53V
C116 .01µF
R136 56
R137 470K
R135 12K
+110V FROM B
-100V FROM D
+110V FROM E
V107B
6922
CATHODE FOLLOWER
R138 12K
YEL-ORN
J102
GATE OUTPUT
-100V
SEE SWEEP TIME SWITCH DETAIL
50K
18K
.1µS TIMING
C121 1.5-7
+370V FROM C
R152 30K
+67V
+180V
5.6
(THIS CAPACITOR IS "PRINTED" ON THE PRINTED CIRCUIT CARD)
B7
+110V
R153 560
R158 10
B6
C122 .01µF
R151 56
(-3.3V)
(-4.1V)
GRN
V109
6CL6
INTEGRATOR
V104B
B4
+110V FROM B
R146 1650
R147 82K
CR103 1N754A
CR104
SWITCH DIODE
6.8V
B
-54V
-9V
-2.8V
-6.8V
V105A
B5
R148 499K
R145 2200
C119 220
C124 68
V115
6922
OUTPUT CATHODE FOLLOWER
+110V
C123 1000
R156 1.3M
R155 56
R150 56
-51V
-54V
V104/V105A
6922
GATE GENERATOR
R144 15K
R149 499K
V105B
6922
CLAMP
-100V FROM D
-100V
R154 56
R157 470K
WHT-ORN
FROM R327 HV POWER SUPPLY
V116 NE2
YEL
-50V
+58V
YEL J105
SWEEP OUTPUT TO AUXILIARY PLUG-IN
B8
+110V
-50
15K
-51
220K
-2.8
1.7K*
-6.3
h
18K
-22
7.5K
-24
22K
+1.6
34K*
-6.3
h
+38
14K
+38
180K
+92
4.9K
-6.3
h
+110V
B9
R175 56
V114A
6922
HOLD-OFF CATHODE FOLLOWER
C134 10
R176 20K
R179 15K
R180 56K
C135 .01µF
R181 56
J104
SWEEP OUTPUT
V114B
6922
CATHODE FOLLOWER
R182 18K
SWEEP OCCURRENCE
NORMAL
SINGLE
WHT-GRN
J105
R173 56
165 2M
BLK-ORN
R174 71.5K
C136 1000
-100V
YEL-ORN
J105
SEE AUXILIARY PLUG-IN
-68V
-17V
YEL-WHT
R183 1M
C143 47
-100V
WHT/ORN
J105
R177 15K
VIO-WHT
R178 20K
SWEEP LENGTH
VIO
-100V
-100V
-100V
-100V
E A B C D
R186 56
R187 56
C139 .02µF
R188 100
C140 .01µF
R189 56
C141 .01µF
R190 100
C142 .01µF
YEL-BRN
RED
VIO-ORN
+110V
+370V
-100V

hematic Diagram


V109
-3.3
15K*
+110
3K
0
0
+67
37K
-6.3
h
0
0
-3.3
15K*
+110
3K
0
h
V115
14K
-50
15K
-54
1.4 M
+110
1.5K
0
h
+110
1.5K
-54
1.4 M
-50
15K
-6.3
h
V105
-50
15K
-51
220K
-2.8
1.7K*
-6.3
h
-2.8
1.7K*
-54
18K
-22
7.5K
0
h
V114
-68
75K
-71
18K
+110
1.5K
+6.3
h
+110
1.5K
-50
70K
-50
20K
0
h
V104
18K
-22
7.5K
-24
22K
+1.6
34K*
-6.3
h
+110
1.5K
-58
120K
-54
18K
0
h
V107
0
12K
-50
485K
+110
1.5K
+6.3
h
+110
1.5K
-54
1.5M
-50
15K
0
h
V103
+38
14K
+38
180K
+92
4.9K
-6.3
h
+110
24K
+13
1.7 M
+38
14K
0
h
V101
-1
9K
-16
10K
+110
2.4K
+6.3
h
+88
6.5K
0
1.5M
+1
9K
0
h
V113
-24
21K
-68
1M
+110
1.5K
+6.3
h
-10
27K
-24
16K
-24
20K
0
h
RO

NOTE
MEASUREMENTS MADE WITH HORIZONTAL DISPLAY SET TO XI, TRIGGER SOURCE SET TO INT, SWEEP MODE SET JUST OUT OF PRESET, TRIGGER SLOPE SET TO +, TRIGGER LEVEL SET CCW.

*MEASUREMENT VARIES DUE TO SEMICONDUCTORS.


CIRCUIT BOARD A101
J101
INPUT
S102
TRIGGER SLOPE
S101
TRIGGER SOURCE
EXT DC
EXT AC
INT
LINE
INT TRIG FROM VERT AMP
6.3 VAC
TO AUXILIARY PLUG-IN
J105
TRIGGER LEVEL
V101A&B
6922
TRIGGER AMPLIFIER
V101B
V102
NE76
TRIG SYM. ADJ.
V103A&B
6922
TRIGGER GENERATOR
V110
NE2
J105
TO AUXILIARY PLUG-IN
SEE AUXILIARY PLUG-IN
SWEEP ARMED
NE2
CR101
CLAMP DIODE
CR102
V104A
V104B
V105A
V104/V105A
6922
GATE GENERATOR
V105B
6922
CLAMP
V106
NE76
V111
NE2
V107A
6922
CATHODE FOLLOWER
UNBLANKING GATE TO AUXILIARY PLUG IN
J105
V107B
6922
CATHODE FOLLOWER
J102
GATE OUTPUT
-100V FROM HORIZONTAL DISPLAY SWITCH S202 IN X1 THRU X1Ø POSITIONS
CR103
IN754A
CR104
SWITCH DIODE
SEE SWEEP TIME SWITCH DETAIL
1μS TIMING
(THIS CAPACITOR IS "PRINTED" ON THE PRINTED CIRCUIT CARD)
V109
6CL6
INTEGRATOR
V115
6922
OUTPUT CATHODE FOLLOWER
V116
NE2
FROM R327 HV POWER SUPPLY
J105
SWEEP OUTPUT TO AUXILIARY PLUG-IN
J104
SWEEP OUTPUT
V114A
6922
HOLD-OFF CATHODE FOLLOWER
V114B
6922
CATHODE FOLLOWER
SWEEP LENGTH
SWEEP OCCURRENCE
NORMAL
SINGLE
SEE AUXILIARY PLUG-IN
S103
(PART OF R162)
SWEEP MODE
PRESET ADJ.
PRESET
V113A&B
6922
BIAS CONTROL CATHODE FOLLOWER
ARMING INPUT
1N277
+370V
+110V
-100V
YEL-BRN
RED
VIO-ORN

NOTES

USE VTVM FOR VOLTAGES IN PARENTHESES.

VOLTAGES AT (B_1) AND (B_2) SHOW RANGE OF *SWEEP MODE* CONTROL WITH *HORIZONTAL DISPLAY* SET TO 1V/CM OTHER VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS:

- *HORIZONTAL DISPLAY* TO X1
- *TRIGGER SOURCE* TO INT
- *SWEEP MODE* TO FREE RUN.
- *TRIGGER SLOPE* TO +
- *TRIGGER LEVEL* FULLY CCW
- *SWEEP TIME* TO 1 SEC/CM
- *VERNIER* TO CAL
- DUAL VOLTAGES SHOW GATE AND SWEEP LIMITS.

ALL VALUES IN OHMS, MICROHENRIES, AND PICOFARADS UNLESS OTHERWISE NOTED.

ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

REF. DESIGNATORS

C101 - 143
CR101 - 104

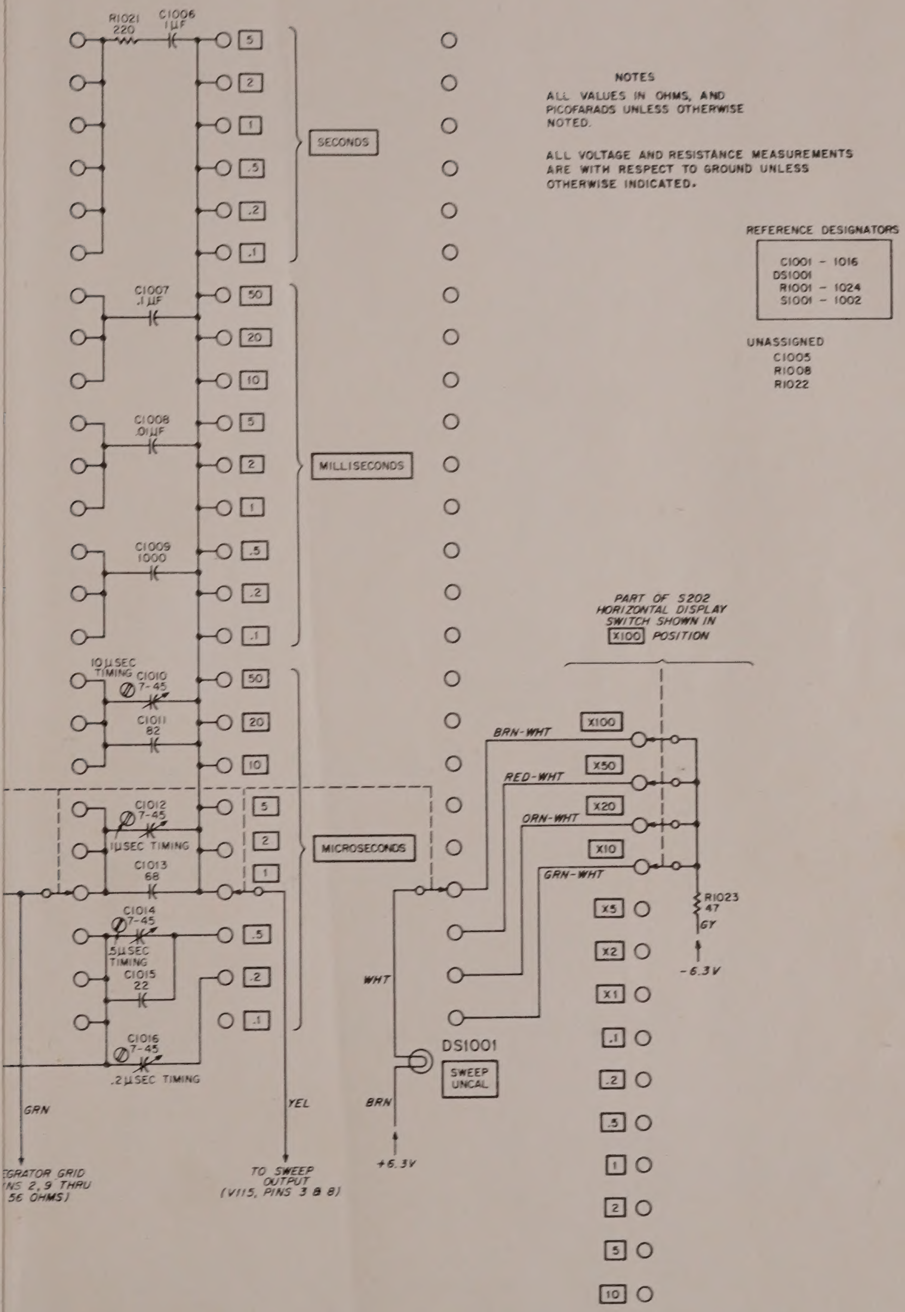
J101 - 105
L101 - 103
R101 - 190
S101 - 103
V101 - 116

UNASSIGNED:
C111 - 113, 125-129, 120, 138, 131
R126 - 129, 159-160, 184-185, 166
V108, 112
J103

THE FOLLOWING SUBSTITUTION IN WIRE COLOR CODE MAYBE FOUND IN SOME EQUIPMENTS

PINK FOR YEL-BLK
PNK-ORN FOR YEL-BRN
PNK-WHT FOR YEL-GRN

Figure 6-13 Sweep Generator Schematic Diagram


R1021
220
C1006
1 µF
5
2
1
.5
.2
.1
SECONDS
C1007
.1 µF
50
20
10
C1008
.01 µF
5
2
1
MILLISECONDS
C1009
1000
.5
.2
.1
10 µSEC
TIMING
C1010
7-45
C1011
82
50
20
10
C1012
7-45
1µSEC TIMING
C1013
68
5
2
1
MICROSECONDS
C1014
7-45
.5µSEC
TIMING
C1015
22
.5
.2
.1
C1016
7-45
.2µSEC TIMING
GRN
EGRATOR GRID
INS 2, 9 THRU
56 OHMS)
YEL
TO SWEEP
OUTPUT
(V115, PINS 3 & 8)
WHT
BRN
+6.3V
DS1001
SWEEP
UNCAL
PART OF S202
HORIZONTAL DISPLAY
SWITCH SHOWN IN
X100 POSITION
X100
BRN-WHT
X50
RED-WHT
X20
ORN-WHT
X10
GRN-WHT
R1023
47
GY
-6.3V
X5
X2
X1
.1
.2
.5
1
2
5
10

NOTES

ALL VALUES IN OHMS, AND PICOFARADS UNLESS OTHERWISE NOTED.

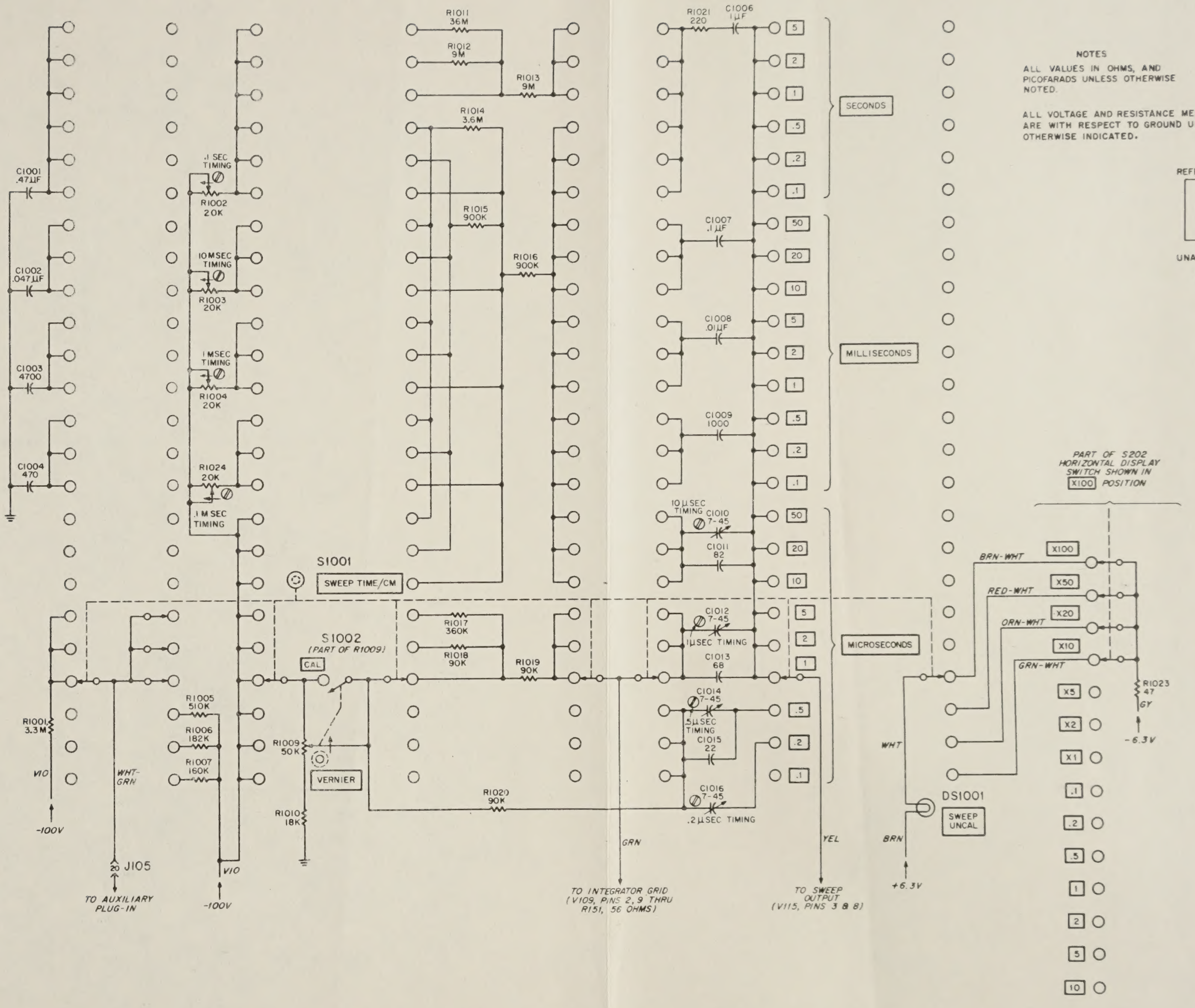
ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

REFERENCE DESIGNATORS

C1001 – 1016
DS1001
R1001 – 1024
S1001 – 1002

UNASSIGNED
C1005
R1008
R1022

Time Switch Schematic Diagram


C1001 .47µF
C1002 .047µF
C1003 4700
C1004 470
R1001 3.3M
VIO
-100V
.1 SEC TIMING
R1002 20K
10MSEC TIMING
R1003 20K
1MSEC TIMING
R1004 20K
R1024 20K
.1 M SEC TIMING
R1005 510K
R1006 182K
R1007 160K
WHT-GRN
J105
TO AUXILIARY PLUG-IN
VIO
-100V
S1001
SWEEP TIME/CM
S1002 (PART OF R1009)
CAL
R1009 50K
VERNIER
R1010 18K
R1011 36M
R1012 9M
R1013 9M
R1014 3.6M
R1015 900K
R1016 900K
R1017 360K
R1018 90K
R1019 90K
R1020 90K
R1021 220
C1006 1µF
C1007 .1µF
C1008 .01µF
C1009 1000
10µSEC TIMING
C1010 7-45
C1011 82
C1012 7-45
1µSEC TIMING
C1013 68
C1014 7-45
.5µSEC TIMING
C1015 22
C1016 7-45
.2µSEC TIMING
5
2
1
.5
.2
.1
50
20
10
5
2
1
.5
.2
.1
50
20
10
5
2
1
5
2
.1
SECONDS
MILLISECONDS
MICROSECONDS
GRN
TO INTEGRATOR GRID (V109, PINS 2, 9 THRU R151, 56 OHMS)
YEL
TO SWEEP OUTPUT (V115, PINS 3 & 8)
PART OF S202 HORIZONTAL DISPLAY SWITCH SHOWN IN X100 POSITION
X100
X50
X20
X10
X5
X2
X1
.1
.2
.5
1
2
5
10
BRN-WHT
RED-WHT
ORN-WHT
GRN-WHT
R1023 47
GY
-6.3V
WHT
BRN
+6.3V
DS1001
SWEEP UNCAL

NOTES
ALL VALUES IN OHMS, AND PICOFARADS UNLESS OTHERWISE NOTED.

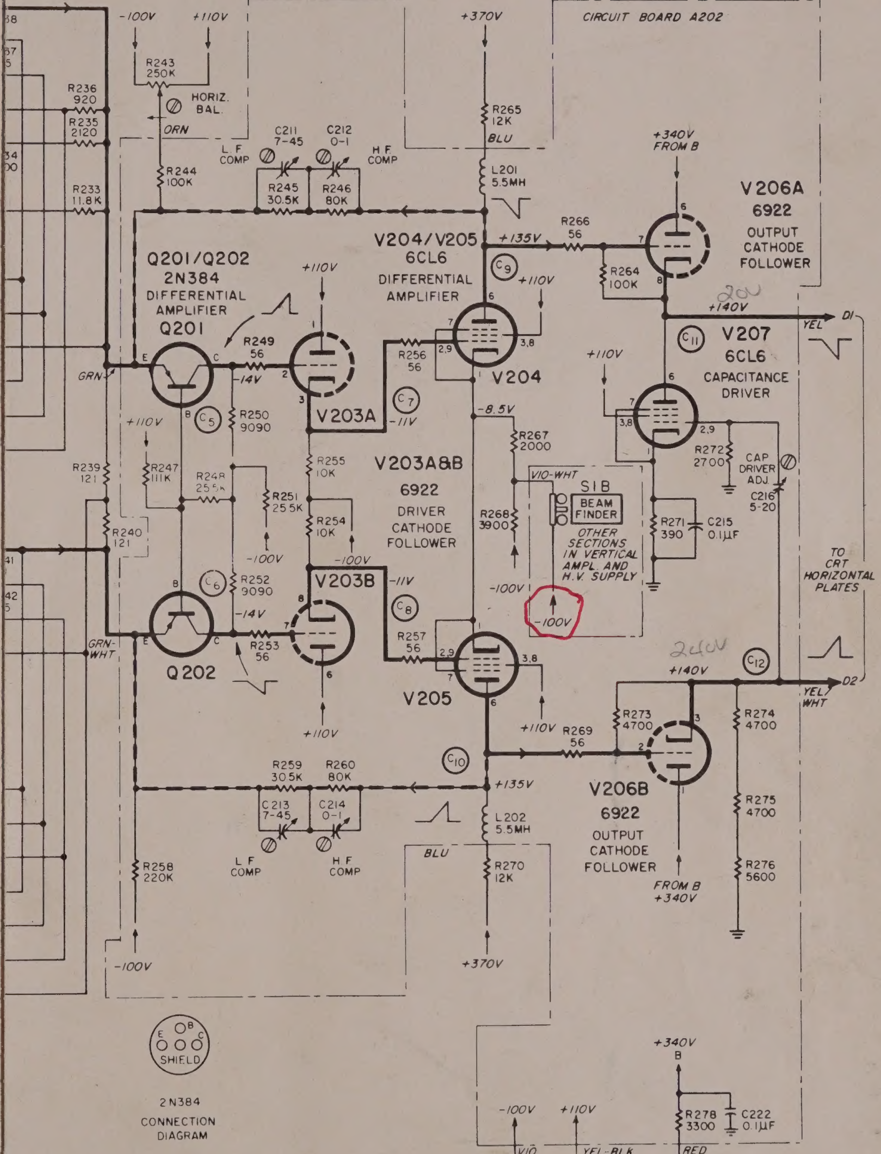
ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

REFERENCE DESIGNATORS
C1001 - 1016
DS1001
R1001 - 1024
S1001 - 1002

UNASSIGNED
C1005
R1008
R1022

Figure 6-14 Sweep Time Switch Schematic Diagram

Figure 6-15



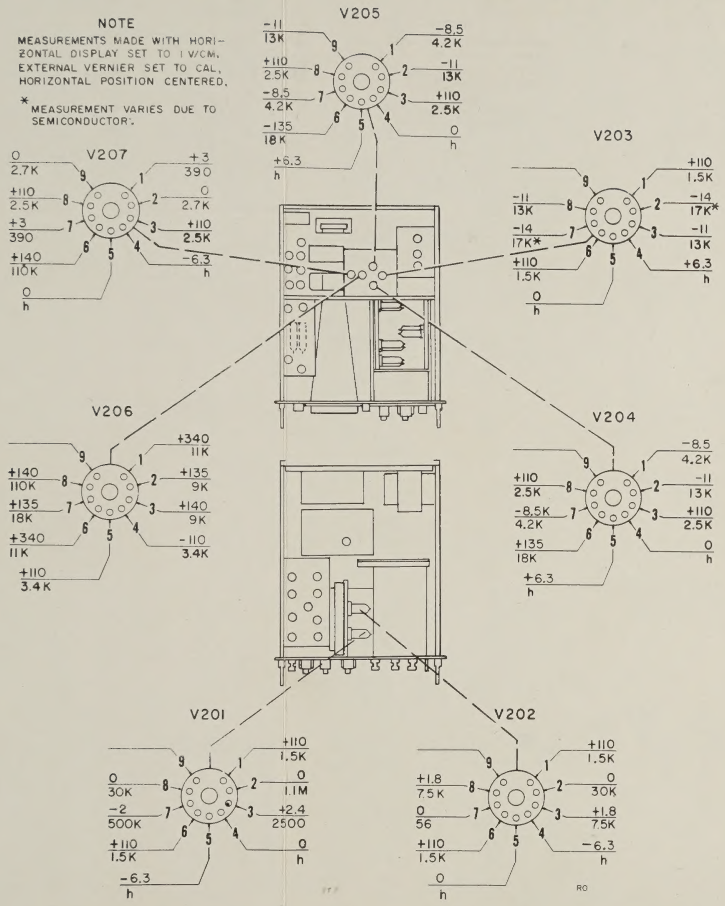
-100V
+110V
R243 250K
HORIZ. BAL.
ORN
R236 920
R235 2120
R233 11.8K
R244 100K
L.F COMP
C211 7-45
C212 0-1
H.F COMP
R245 30.5K
R246 80K
+370V
CIRCUIT BOARD A202
R265 12K
BLU
L201 5.5MH
+340V FROM B
V206A 6922 OUTPUT CATHODE FOLLOWER
R266 56
+135V
V204/V205 6CL6 DIFFERENTIAL AMPLIFIER
R264 100K
Q201/Q202 2N384 DIFFERENTIAL AMPLIFIER
Q201
C9
+110V
20V
+140V
DI
YEL
R249 56
GRN
-14V
R256 56
2,9
3,8
V204
C11
V207 6CL6 CAPACITANCE DRIVER
C5
V203A
C7
-11V
-8.5V
R250 9090
R267 2000
R272 2700
CAP DRIVER ADJ
C216 5-20
R239 121
R247 111K
R248 25.5K
R255 10K
V203A&B 6922 DRIVER CATHODE FOLLOWER
VIO-WHT
S1B BEAM FINDER
R251 25.5K
R254 10K
R268 3900
OTHER SECTIONS IN VERTICAL AMPL. AND H.V. SUPPLY
R271 390
C215 0.1µF
R240 121
-100V
TO CRT HORIZONTAL PLATES
C6
R252 9090
V203B
-11V
C8
-100V
-14V
R257 56
240V
C12
GRN-WHT
R253 56
Q202
V205
+140V
D2
YEL/WHT
R273 4700
R274 4700
+110V
R269 56
C10
V206B 6922 OUTPUT CATHODE FOLLOWER
R259 30.5K
R260 80K
+135V
C213 7-45
C214 0-1
L202 5.5MH
R275 4700
L.F COMP
H.F COMP
BLU
R258 220K
R270 12K
FROM B +340V
R276 5600
+370V
E B C SHIELD
2N384 CONNECTION DIAGRAM
+340V B
R278 3300
C222 0.1µF
VIO
YEL-BLK
RED
+370V

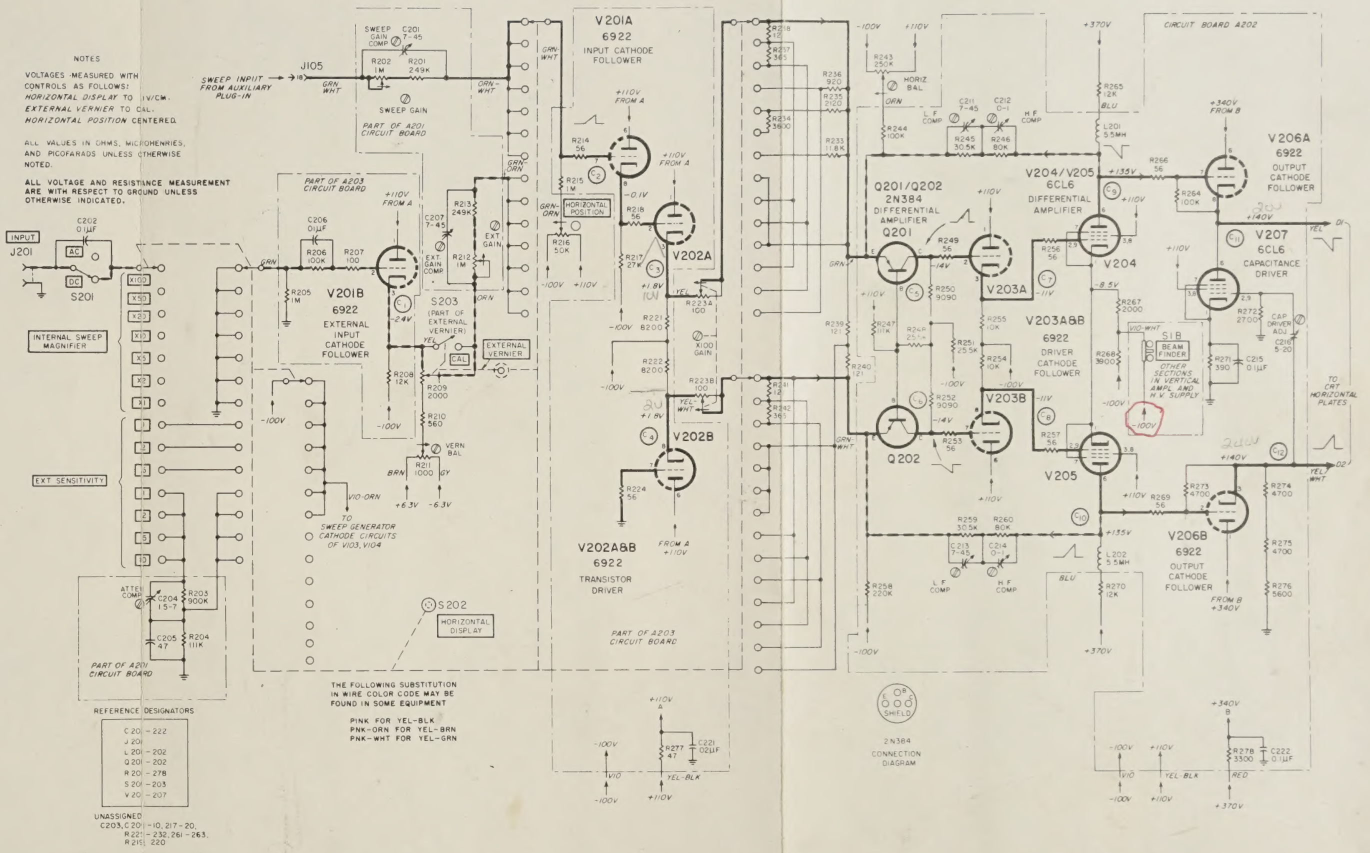
tic Diagram

NOTE

MEASUREMENTS MADE WITH HORIZONTAL DISPLAY SET TO 1 V/CM, EXTERNAL VERNIER SET TO CAL, HORIZONTAL POSITION CENTERED.

* MEASUREMENT VARIES DUE TO SEMICONDUCTOR.


V205
-11
13K
-8.5
4.2K
+110
2.5K
-11
13K
-8.5
4.2K
+110
2.5K
-135
18K
0
h
+6.3
h
V207
0
2.7K
+3
390
+110
2.5K
0
2.7K
+3
390
+110
2.5K
+140
110K
-6.3
h
0
h
V203
+110
1.5K
-11
13K
-14
17K*
-14
17K*
-11
13K
+110
1.5K
+6.3
h
0
h
V206
+340
11K
+140
110K
+135
9K
+135
18K
+140
9K
+340
11K
-110
3.4K
+110
3.4K
V204
-8.5
4.2K
+110
2.5K
-11
13K
-8.5K
4.2K
+110
2.5K
+135
18K
0
h
+6.3
h
V201
+110
1.5K
0
30K
0
1.1M
-2
500K
+2.4
2500
+110
1.5K
0
h
-6.3
h
V202
+110
1.5K
+1.8
7.5K
0
30K
0
56
+1.8
7.5K
+110
1.5K
-6.3
h
0
h
RO


SWEEP INPUT FROM AUXILIARY PLUG-IN
J105
INPUT
J201
C202 0.1μF
AC
DC
S201
INTERNAL SWEEP MAGNIFIER
EXT SENSITIVITY
SWEEP GAIN
PART OF A201 CIRCUIT BOARD
PART OF A203 CIRCUIT BOARD
V201A
6922
INPUT CATHODE FOLLOWER
V201B
6922
EXTERNAL INPUT CATHODE FOLLOWER
S203 (PART OF EXTERNAL VERNIER)
EXTERNAL VERNIER
CAL
EXT GAIN
EXT GAIN COMP
VERN BAL
HORIZONTAL POSITION
X100 GAIN
V202A
V202B
V202A&B
6922
TRANSISTOR DRIVER
PART OF A203 CIRCUIT BOARD
TO SWEEP GENERATOR CATHODE CIRCUITS OF V103, V104
S202
HORIZONTAL DISPLAY
ATTEN COMP
HORIZ BAL
L F COMP
H F COMP
Q201/Q202
2N384
DIFFERENTIAL AMPLIFIER
Q201
Q202
V203A
V203B
V203A&B
6922
DRIVER CATHODE FOLLOWER
V204/V205
6CL6
DIFFERENTIAL AMPLIFIER
V204
V205
V206A
6922
OUTPUT CATHODE FOLLOWER
V206B
6922
OUTPUT CATHODE FOLLOWER
V207
6CL6
CAPACITANCE DRIVER
CAP DRIVER ADJ
S1B BEAM FINDER
OTHER SECTIONS IN VERTICAL AMPL AND H V SUPPLY
CIRCUIT BOARD A202
TO CRT HORIZONTAL PLATES
2N384 CONNECTION DIAGRAM
SHIELD
+370V
+340V
+110V
-100V
YEL-BLK

NOTES

VOLTAGES MEASURED WITH CONTROLS AS FOLLOWS:
HORIZONTAL DISPLAY TO 1V/CM.
EXTERNAL VERNIER TO CAL.
HORIZONTAL POSITION CENTERED.

ALL VALUES IN OHMS, MICROHENRIES, AND PICOFARADS UNLESS OTHERWISE NOTED.

ALL VOLTAGE AND RESISTANCE MEASUREMENT ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

REFERENCE DESIGNATORS

C201 - 222
J201
L201 - 202
Q201 - 202
R201 - 278
S201 - 203
V201 - 207

UNASSIGNED
C203, C208-10, 217-20,
R225-232, 261-263,
R219, 220

THE FOLLOWING SUBSTITUTION IN WIRE COLOR CODE MAY BE FOUND IN SOME EQUIPMENT

PINK FOR YEL-BLK
PNK-ORN FOR YEL-BRN
PNK-WHT FOR YEL-GRN

Figure 6-15 *Horizontal Amplifier Schematic Diagram*

THE FOLLOWING SUBSTITUTION IN WIRE COLOR CODE MAY BE FOUND IN SOME EQUIPMENTS.

PINK FOR YEL-BLK
PNK-ORN FOR YEL-BLK
PNK-WHT FOR YEL-GRN

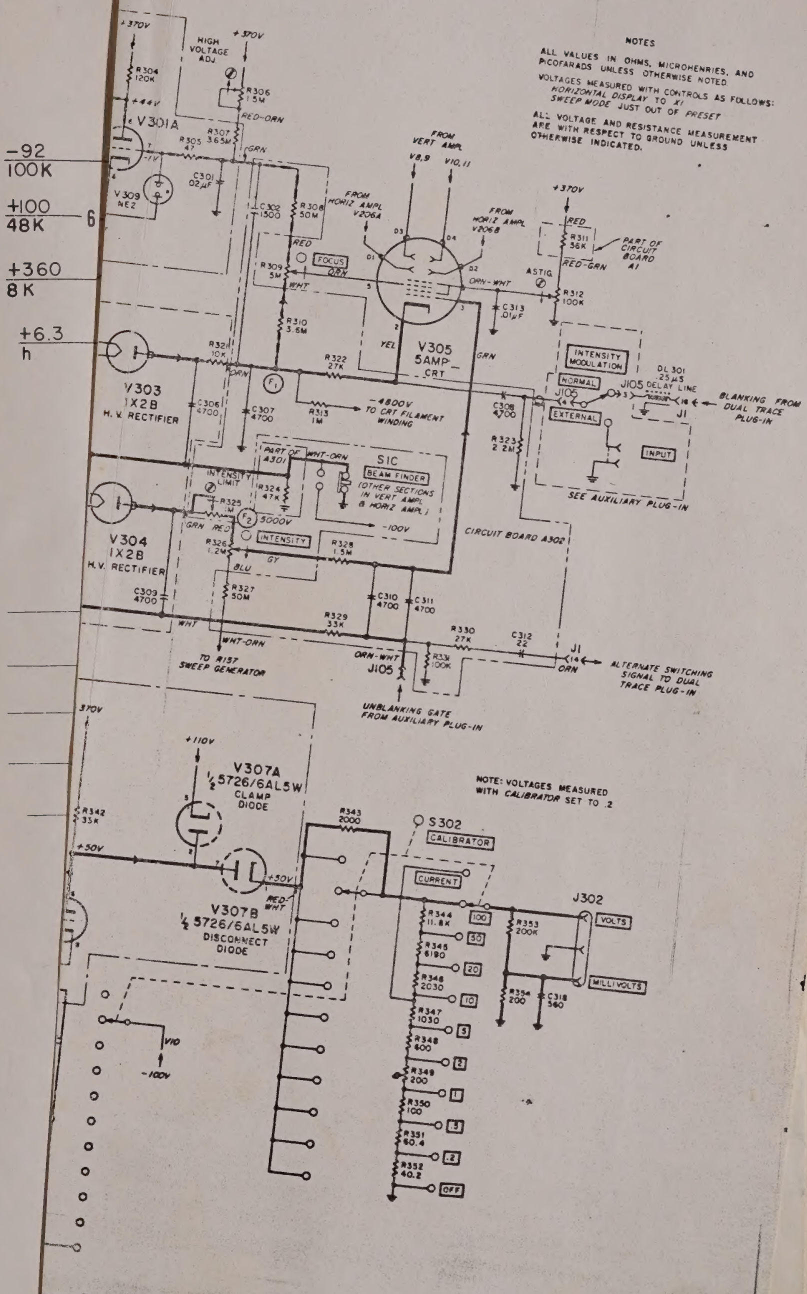
NOTES

ALL VALUES IN OHMS, MICROHENRIES, AND PICOFARADS UNLESS OTHERWISE NOTED.

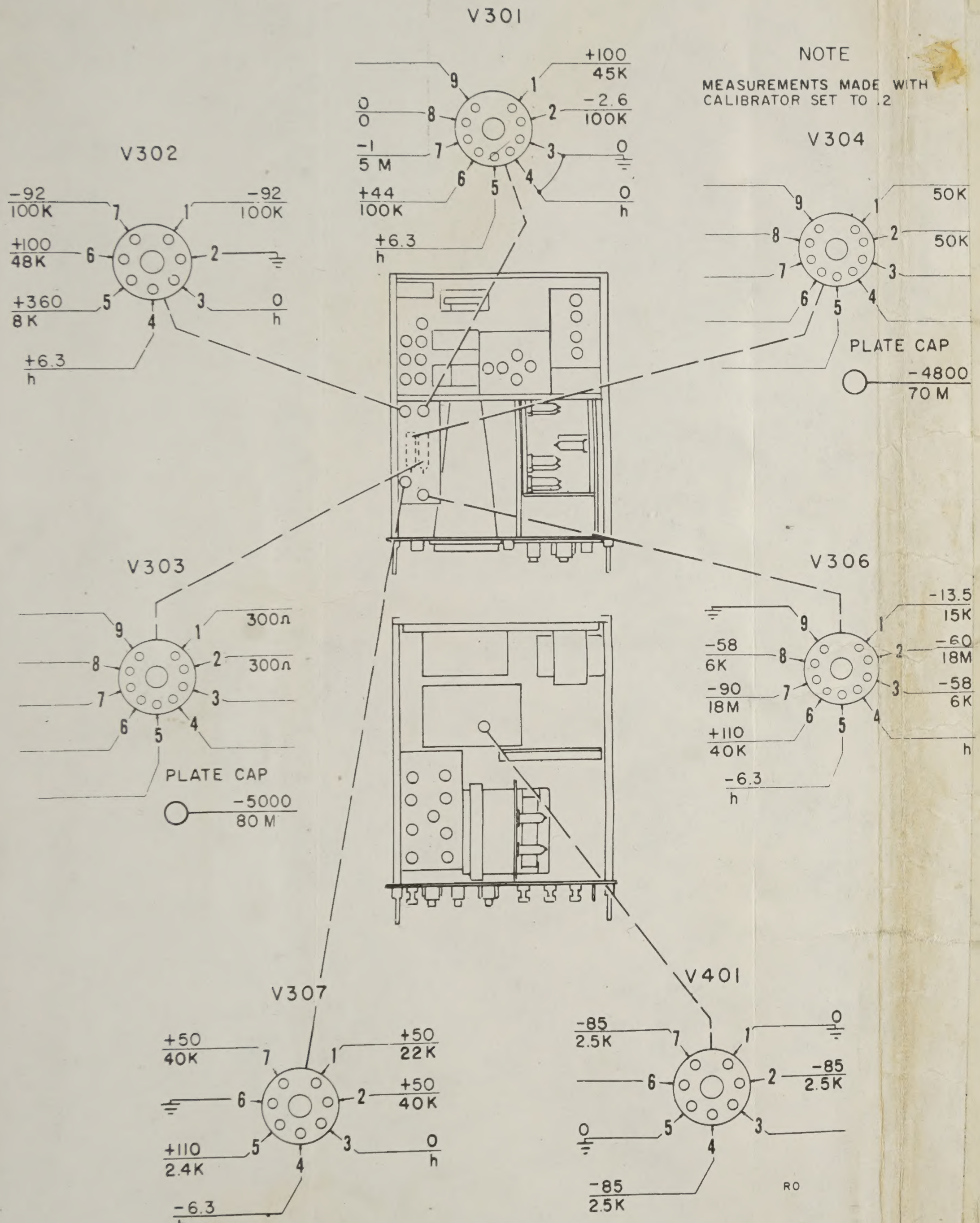
VOLTAGES MEASURED WITH CONTROLS AS FOLLOWS: HORIZONTAL DISPLAY TO X1 SWEEP MODE JUST OUT OF PRESET

ALL VOLTAGE AND RESISTANCE MEASUREMENT ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

NOTE: VOLTAGES MEASURED WITH CALIBRATOR SET TO .2

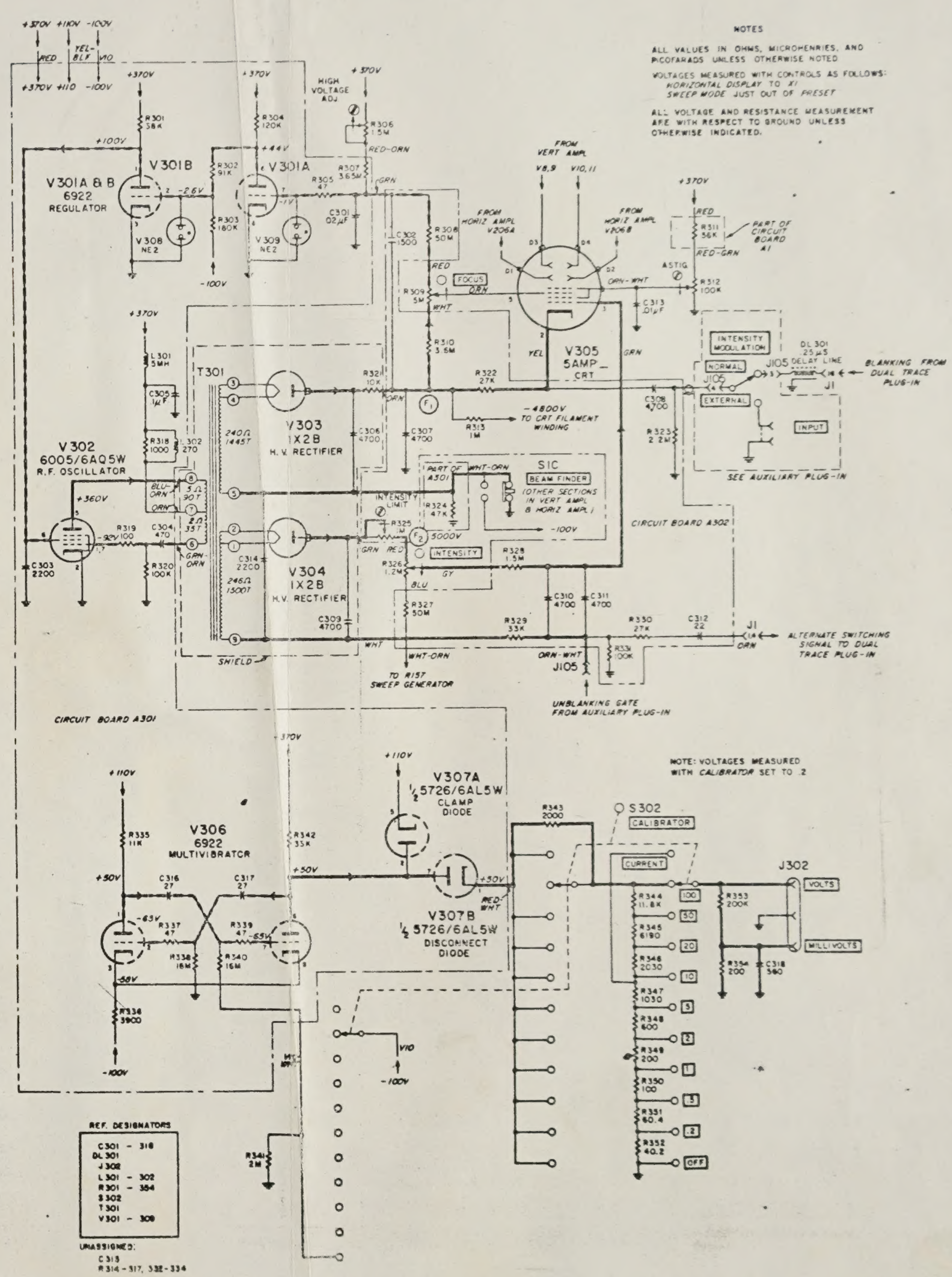

-92
100K
+100
48K
6
+360
8K
+6.3
h
+370V
HIGH VOLTAGE ADJ
+370V
R304 120K
R306 1.5M
+44V
V301A
RED-ORN
R307 3.65M
R305 47
-1V
GRN
C301 .02μF
V309 NE2
C302 1500
R308 50M
FROM HORIZ AMPL V206A
FROM VERT AMPL
V8,9
V10,11
FROM HORIZ AMPL V206B
+370V
RED
R311 56K
PART OF CIRCUIT BOARD A1
RED-GRN
ASTIG
R312 100K
RED
FOCUS
ORN
R309 5M
WHT
ORN-WHT
C313 .01μF
R310 3.6M
R321 10K
YEL
V305 5AMP CRT
GRN
R322 27K
ORN
INTENSITY MODULATION
NORMAL
J105
EXTERNAL
DL 301 .25μS DELAY LINE
J1
BLANKING FROM DUAL TRACE PLUG-IN
INPUT
V303 1X2B H.V. RECTIFIER
C306 4700
C307 4700
R313 1M
-4800V TO CRT FILAMENT WINDING
C308 4700
R323 2.2M
PART OF A301
WHT-ORN
S1C BEAM FINDER
(OTHER SECTIONS IN VERT AMPL & HORIZ AMPL)
INTENSITY LIMIT
R324 47K
R325 1M
5000V
-100V
SEE AUXILIARY PLUG-IN
GRN RED
INTENSITY
R328 1.5M
CIRCUIT BOARD A302
V304 1X2B H.V. RECTIFIER
R326 1.2M
GY
BLU
R327 50M
C309 4700
C310 4700
C311 4700
R329 33K
WHT
WHT-ORN
R330 27K
C312 22
J1
ORN
ORN-WHT
R331 100K
J105
TO R137 SWEEP GENERATOR
ALTERNATE SWITCHING SIGNAL TO DUAL TRACE PLUG-IN
UNBLANKING GATE FROM AUXILIARY PLUG-IN
370V
+110V
V307A ½ 5726/6AL5W CLAMP DIODE
R342 33K
+50V
R343 2000
S302 CALIBRATOR
CURRENT
+50V
RED-WHT
V307B ½ 5726/6AL5W DISCONNECT DIODE
J302
R344 11.8K
100
R353 200K
VOLTS
50
R345 6190
20
R346 2030
MILLIVOLTS
10
R354 200
C318 360
R347 1030
5
R348 600
2
R349 200
1
R350 100
.5
R351 60.4
.2
R352 40.2
OFF
V10
-100V

age Power Supply and Calibrator Schematic Diagram


V301
+100
45K
0
0
-2.6
100K
-1
5 M
0
+44
100K
0
h
+6.3
h
V302
-92
100K
-92
100K
+100
48K
+360
8 K
0
h
+6.3
h
V304
50K
50K
PLATE CAP
-4800
70 M
V303
300Ω
300Ω
PLATE CAP
-5000
80 M
V306
-13.5
15K
-58
6K
-60
18M
-90
18M
-58
6K
+110
40K
-6.3
h
h
V307
+50
40K
+50
22K
+50
40K
+110
2.4K
0
h
-6.3
h
V401
-85
2.5K
0
-85
2.5K
0
-85
2.5K
RO

NOTE

MEASUREMENTS MADE WITH CALIBRATOR SET TO .2


+370V +110V -100V
RED YEL-BLK VIO
V301A & B
6922
REGULATOR
V301B
V301A
HIGH VOLTAGE ADJ
V308 NE2
V309 NE2
V302
6005/6AQ5W
R.F. OSCILLATOR
T301
V303
1X2B
H.V. RECTIFIER
V304
1X2B
H.V. RECTIFIER
V305
5AMP
CRT
FOCUS
ASTIG
INTENSITY
INTENSITY LIMIT
BEAM FINDER
S1C
FROM VERT AMPL
FROM HORIZ AMPL
-4800V TO CRT FILAMENT WINDING
INTENSITY MODULATION
NORMAL
EXTERNAL
INPUT
DL 301
BLANKING FROM DUAL TRACE PLUG-IN
SEE AUXILIARY PLUG-IN
CIRCUIT BOARD A302
ALTERNATE SWITCHING SIGNAL TO DUAL TRACE PLUG-IN
UNBLANKING GATE FROM AUXILIARY PLUG-IN
TO R157 SWEEP GENERATOR
SHIELD
CIRCUIT BOARD A301
V306
6922
MULTIVIBRATOR
V307A
½ 5726/6AL5W
CLAMP DIODE
V307B
½ 5726/6AL5W
DISCONNECT DIODE
S302
CALIBRATOR
CURRENT
J302
VOLTS
MILLIVOLTS
100
50
20
10
5
2
1
.5
.2
OFF

THE FOLLOWING SUBSTITUTION IN WIRE COLOR CODE MAY BE FOUND IN SOME EQUIPMENTS.

PINK FOR YEL-BLK
PNK-ORN FOR YEL-BLK
PNK-WHT FOR YEL-GRN

NOTES

ALL VALUES IN OHMS, MICROHENRIES, AND PICOFARADS UNLESS OTHERWISE NOTED

VOLTAGES MEASURED WITH CONTROLS AS FOLLOWS:
HORIZONTAL DISPLAY TO X1
SWEEP MODE JUST OUT OF PRESET

ALL VOLTAGE AND RESISTANCE MEASUREMENT ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

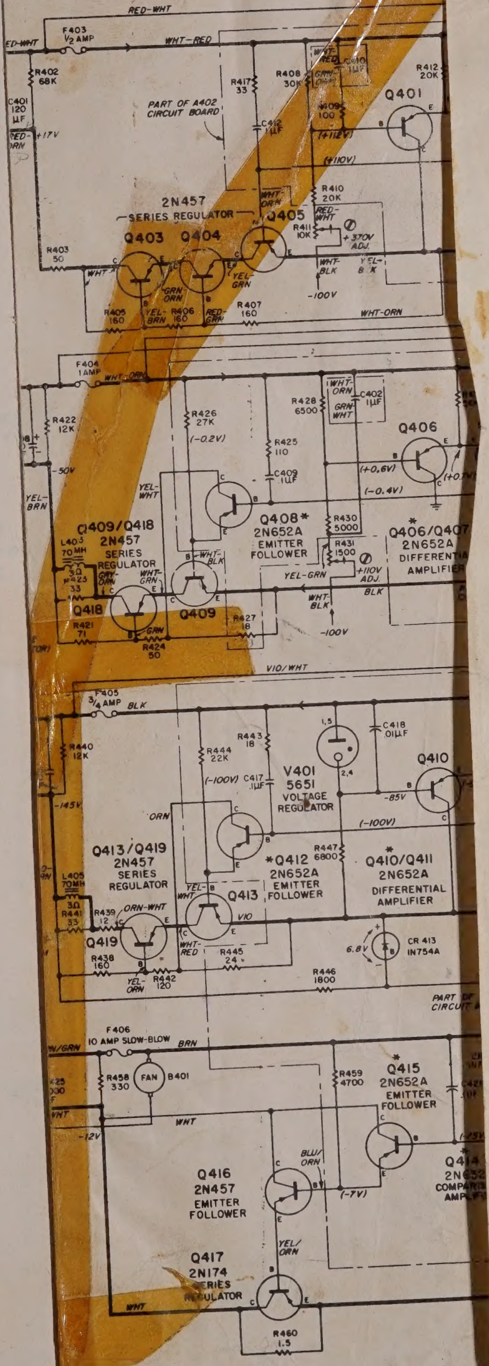
NOTE: VOLTAGES MEASURED WITH CALIBRATOR SET TO .2

REF. DESIGNATORS

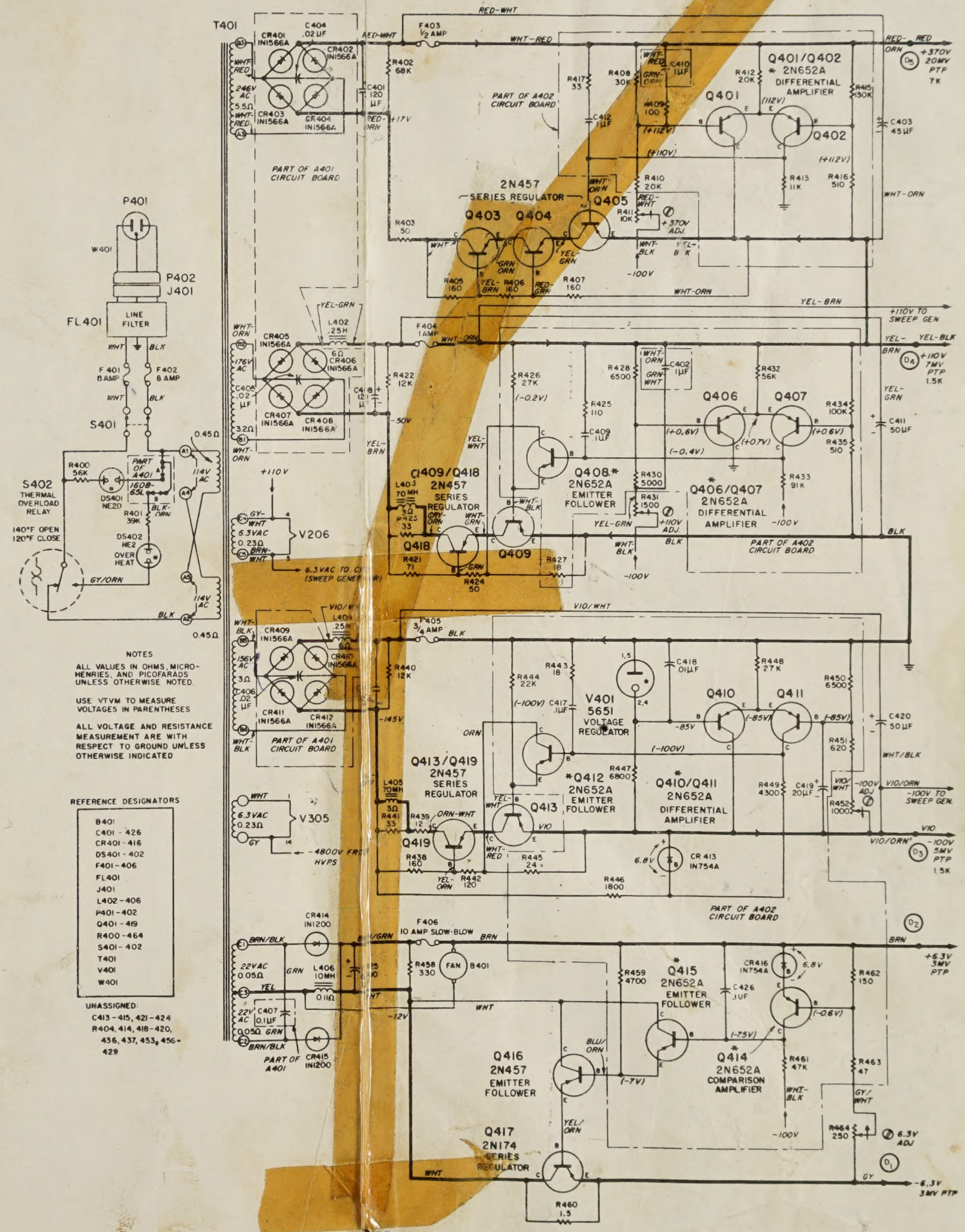
C301 - 318
DL 301
J302
L301 - 302
R301 - 354
S302
T301
V301 - 309

UNASSIGNED:
C313
R314 - 317, 332 - 334

Figure 6-16 High Voltage Power Supply and Calibrator Schematic Diagram


RED-WHT
F403
1/2 AMP
WHT-RED
R402
68K
C401
120
μF
+17V
PART OF A402
CIRCUIT BOARD
R417
33
R408
30K
C410
1μF
R412
20K
R409
100
C412
1μF
(+112V)
(+110V)
Q401
R410
20K
2N457
SERIES REGULATOR
Q403
Q404
Q405
R411
10K
+370V
ADJ.
R403
50
WHT-BLK
YEL-BLK
YEL-GRN
GRN-ORN
-100V
R405
160
YEL-BRN
R406
160
RED-GRN
R407
160
WHT-ORN
F404
1AMP
WHT-ORN
R422
12K
R426
27K
(-0.2V)
R428
6500
WHT-ORN
GRN-WHT
C402
1μF
Q406
R425
110
C409
.1μF
(+0.6V)
(-0.4V)
(+0.7V)
-50V
YEL-BRN
YEL-WHT
Q408*
2N652A
EMITTER
FOLLOWER
R430
5000
R431
1500
+110V
ADJ.
Q406/Q407
2N652A
DIFFERENTIAL
AMPLIFIER
Q409/Q418
2N457
SERIES
REGULATOR
L403
70 MH
3Ω
R423
33
WHT-BLK
WHT-GRN
YEL-GRN
BLK
Q418
Q409
R421
71
R424
50
R427
18
-100V
VIO/WHT
F405
3/4 AMP
BLK
R440
12K
R443
18
R444
22K
C418
.01μF
(-100V)
C417
.1μF
V401
5651
VOLTAGE
REGULATOR
Q410
-85V
-145V
ORN
(-100V)
Q413/Q419
2N457
SERIES
REGULATOR
R447
6800
*Q412
2N652A
EMITTER
FOLLOWER
Q410/Q411
2N652A
DIFFERENTIAL
AMPLIFIER
L405
70MH
3Ω
R441
33
R439
12
ORN-WHT
YEL-WHT
Q413
VIO
Q419
WHT-RED
R445
24
6.8V
CR 413
IN754A
R438
160
YEL-ORN
R442
120
R446
1800
PART OF
F406
10 AMP SLOW-BLOW
BRN
R458
330
FAN
B401
R459
4700
Q415
2N652A
EMITTER
FOLLOWER
WHT
-12V
BLU/ORN
(-15V)
Q416
2N457
EMITTER
FOLLOWER
(-7V)
COMPAR
YEL/ORN
Q417
2N174
SERIES
REGULATOR
WHT
R460
1.5

6-17 Low Voltage Power Supply Schema


T401
P401
W401
P402
J401
FL401
LINE FILTER
F401 8 AMP
F402 8 AMP
S401
S402 THERMAL OVERLOAD RELAY
140°F OPEN 120°F CLOSE
R400 56K
DS401 NE2D
R401 39K
DS402 NE2 OVER HEAT
114V AC
0.45Ω
GY/ORN
BLK
CR401 IN1566A
CR402 IN1566A
CR403 IN1566A
CR404 IN1566A
C404 .02 μF
246V AC
5.5Ω
C401 120 μF
PART OF A401 CIRCUIT BOARD
RED-WHT
F403 1/2 AMP
WHT-RED
R402 68K
PART OF A402 CIRCUIT BOARD
R417 33
R408 30K
C410 1 μF
R409 100
C412 1 μF
(+112V)
(+110V)
Q401/Q402 * 2N652A DIFFERENTIAL AMPLIFIER
Q401
Q402
R412 20K
R415 130K
C403 45 μF
R413 11K
R416 510
+370V 20MV PTP 7K
R410 20K
R411 10K
+370V ADJ
2N457 SERIES REGULATOR
Q403
Q404
Q405
R403 50
R405 160
R406 160
R407 160
-100V
WHT-ORN
YEL-BRN
+110V TO SWEEP GEN
YEL-BLK
CR405 IN1566A
CR406 IN1566A
CR407 IN1566A
CR408 IN1566A
L402 .25H
176V AC
C405 .02 μF
3.2Ω
F404 1 AMP
C408 121 μF
-50V
R422 12K
R426 27K
(-0.2V)
R425 110
C409 1 μF
R428 6500
C402 1 μF
R432 56K
R434 100K
R435 510
Q406
Q407
(+0.6V)
(+0.7V)
(-0.4V)
C411 50 μF
+110V 7MV PTP 1.5K
Q409/Q418 2N457 SERIES REGULATOR
Q408* 2N652A EMITTER FOLLOWER
R430 5000
R431 1500
+110V ADJ
R433 91K
Q406/Q407 * 2N652A DIFFERENTIAL AMPLIFIER
PART OF A402 CIRCUIT BOARD
L403 70MH
R422 33
Q418
Q409
R421 71
R424 50
R427 18
V206
6.3VAC 0.23Ω
6.3VAC TO CRT (SWEEP GENERATOR)
VIO/WHT
CR409 IN1566A
CR410 IN1566A
CR411 IN1566A
CR412 IN1566A
L404 .25H
156V AC
3Ω
C406 .02 μF
F405 3/4 AMP
R440 12K
R444 22K
R443 18
C418 .01 μF
V401 5651 VOLTAGE REGULATOR
C417 1 μF
R448 27K
R450 6500
Q410
Q411
(-85V)
C420 50 μF
R451 620
-145V
Q413/Q419 2N457 SERIES REGULATOR
*Q412 2N652A EMITTER FOLLOWER
R447 6800
Q410/Q411 * 2N652A DIFFERENTIAL AMPLIFIER
R449 4300
C419 20 μF
R452 1000
-100V ADJ
-100V TO SWEEP GEN
-100V 5MV PTP 1.5K
L405 70MH
R441 33
R439 12
Q419
Q413
R438 160
R445 24
R442 120
R446 1800
CR413 IN754A
6.8V
V305
-4800V FROM HVPS
PART OF A402 CIRCUIT BOARD
CR414 IN1200
F406 10 AMP SLOW-BLOW
22VAC 0.05Ω
L406 10MH
0.11Ω
C407 0.1 μF
R458 330
FAN B401
R459 4700
Q415 2N652A EMITTER FOLLOWER
C426 1 μF
CR416 IN754A
R462 150
+6.3V 3MV PTP
Q416 2N457 EMITTER FOLLOWER
Q414 * 2N652A COMPARISON AMPLIFIER
R461 47K
R463 47
R464 250
6.3V ADJ
-12V
(-7V)
(-75V)
(-0.6V)
Q417 2N174 SERIES REGULATOR
R460 1.5
-6.3V 3MV PTP
CR415 IN1200
PART OF A401

NOTES

ALL VALUES IN OHMS, MICROHENRIES, AND PICOFARADS UNLESS OTHERWISE NOTED.

USE VTVM TO MEASURE VOLTAGES IN PARENTHESES

ALL VOLTAGE AND RESISTANCE MEASUREMENT ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED

REFERENCE DESIGNATORS

- B401
- C401 - 426
- CR401 - 416
- DS401 - 402
- F401 - 406
- FL401
- J401
- L402 - 406
- P401 - 402
- Q401 - 419
- R400 - 464
- S401 - 402
- T401
- V401
- W401

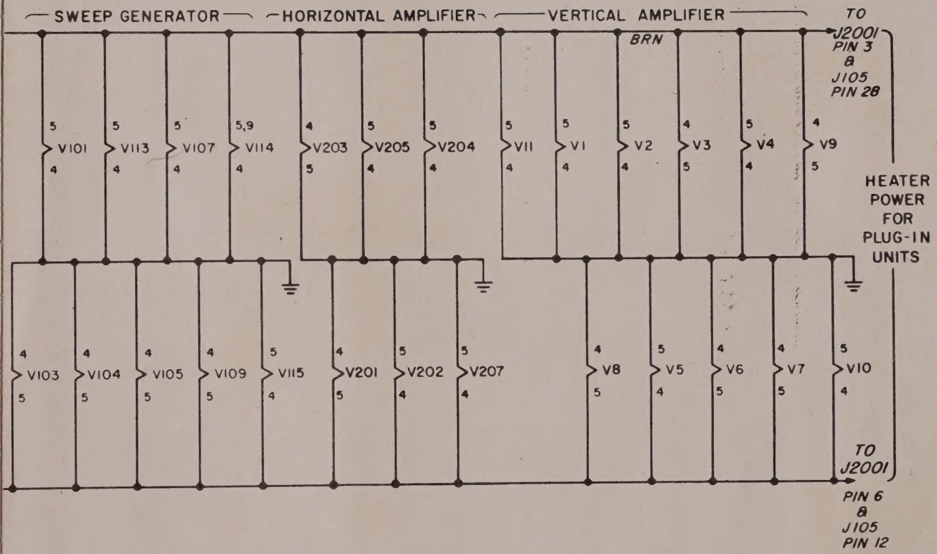
UNASSIGNED:
C413 - 415, 421 - 424
R404, 414, 418 - 420, 436, 437, 453, 456 - 429

*SOME EQUIPMENT MAY BE SUPPLIED WITH TYPE 2N526 TRANSISTORS.

THE FOLLOWING SUBSTITUTION IN WIRE COLOR CODE MAY BE FOUND IN SOME EQUIPMENTS

PINK FOR YEL-BLK
PNK-ORN FOR YEL-BRN
PNK-WHT FOR YEL-GRN

Fi[illegible]6-17 Low Voltage Power Supply Schematic Diagram


SWEEP GENERATOR
HORIZONTAL AMPLIFIER
VERTICAL AMPLIFIER
BRN
TO J2001 PIN 3 & J105 PIN 28
HEATER POWER FOR PLUG-IN UNITS
TO J2001 PIN 6 & J105 PIN 12
V101
V113
V107
V114
V203
V205
V204
V11
V1
V2
V3
V4
V9
V103
V104
V105
V109
V115
V201
V202
V207
V8
V5
V6
V7
V10
5,9

REFERENCE DESIGNATORS

DS 403 - 406
S 403
R1023, 1025

re 6-18 Heater Supply Schematic

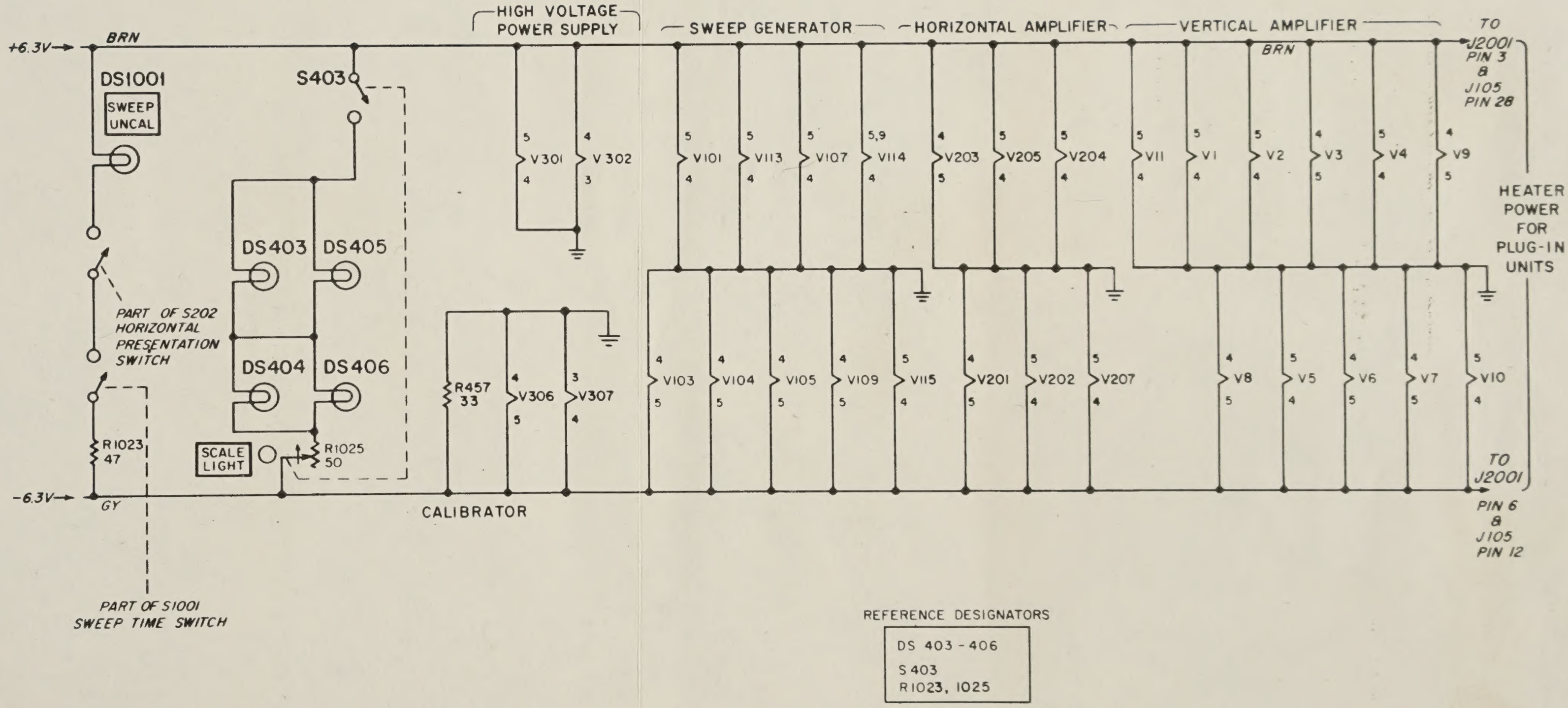
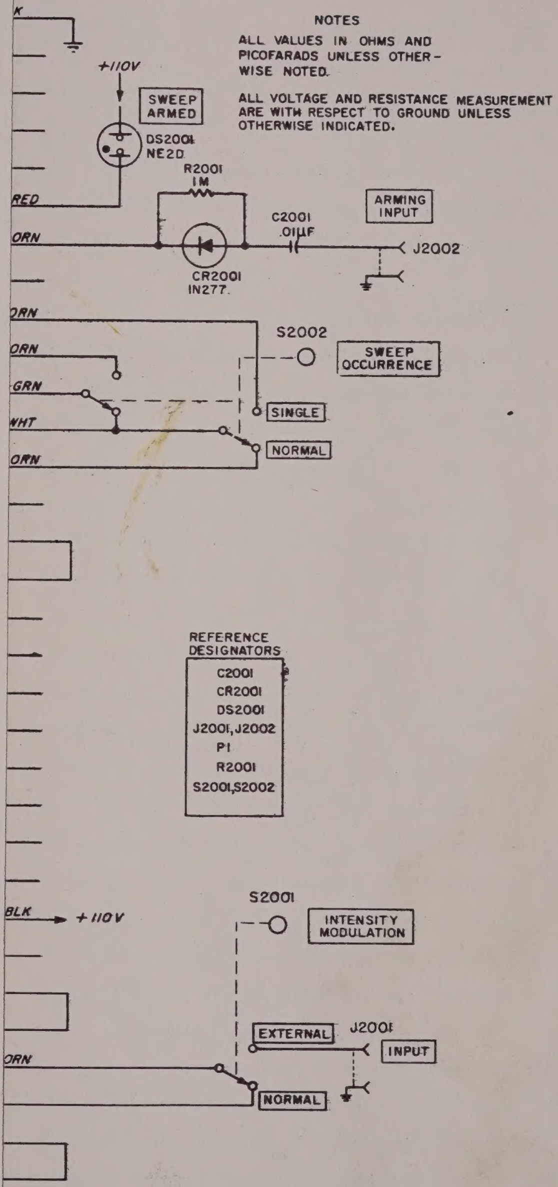

+6.3V
BRN
DS1001
SWEEP UNCAL
S403
DS403
DS405
DS404
DS406
PART OF S202 HORIZONTAL PRESENTATION SWITCH
R1023 47
SCALE LIGHT
R1025 50
-6.3V
GY
PART OF S1001 SWEEP TIME SWITCH
HIGH VOLTAGE POWER SUPPLY
V301
V 302
SWEEP GENERATOR
V101
V113
V107
V114
HORIZONTAL AMPLIFIER
V203
V205
V204
VERTICAL AMPLIFIER
V11
V1
V2
V3
V4
V9
BRN
R457 33
V306
V307
CALIBRATOR
V103
V104
V105
V109
V115
V201
V202
V207
V8
V5
V6
V7
V10
TO J2001 PIN 3 & J105 PIN 28
HEATER POWER FOR PLUG-IN UNITS
TO J2001 PIN 6 & J105 PIN 12
REFERENCE DESIGNATORS
DS 403 - 406
S 403
R1023, 1025

Figure 6-18 Heater Supply Schematic

Figure
6-20


K
+110V
SWEEP ARMED
DS2001
NE2D
R2001
1M
RED
ORN
CR2001
1N277
C2001
.01µF
ARMING INPUT
J2002
ORN
S2002
ORN
SWEEP OCCURRENCE
GRN
SINGLE
WHT
NORMAL
ORN
BLK
+110V
S2001
INTENSITY MODULATION
EXTERNAL
J2001
INPUT
ORN
NORMAL

NOTES

ALL VALUES IN OHMS AND PICOFARADS UNLESS OTHERWISE NOTED.

ALL VOLTAGE AND RESISTANCE MEASUREMENT ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

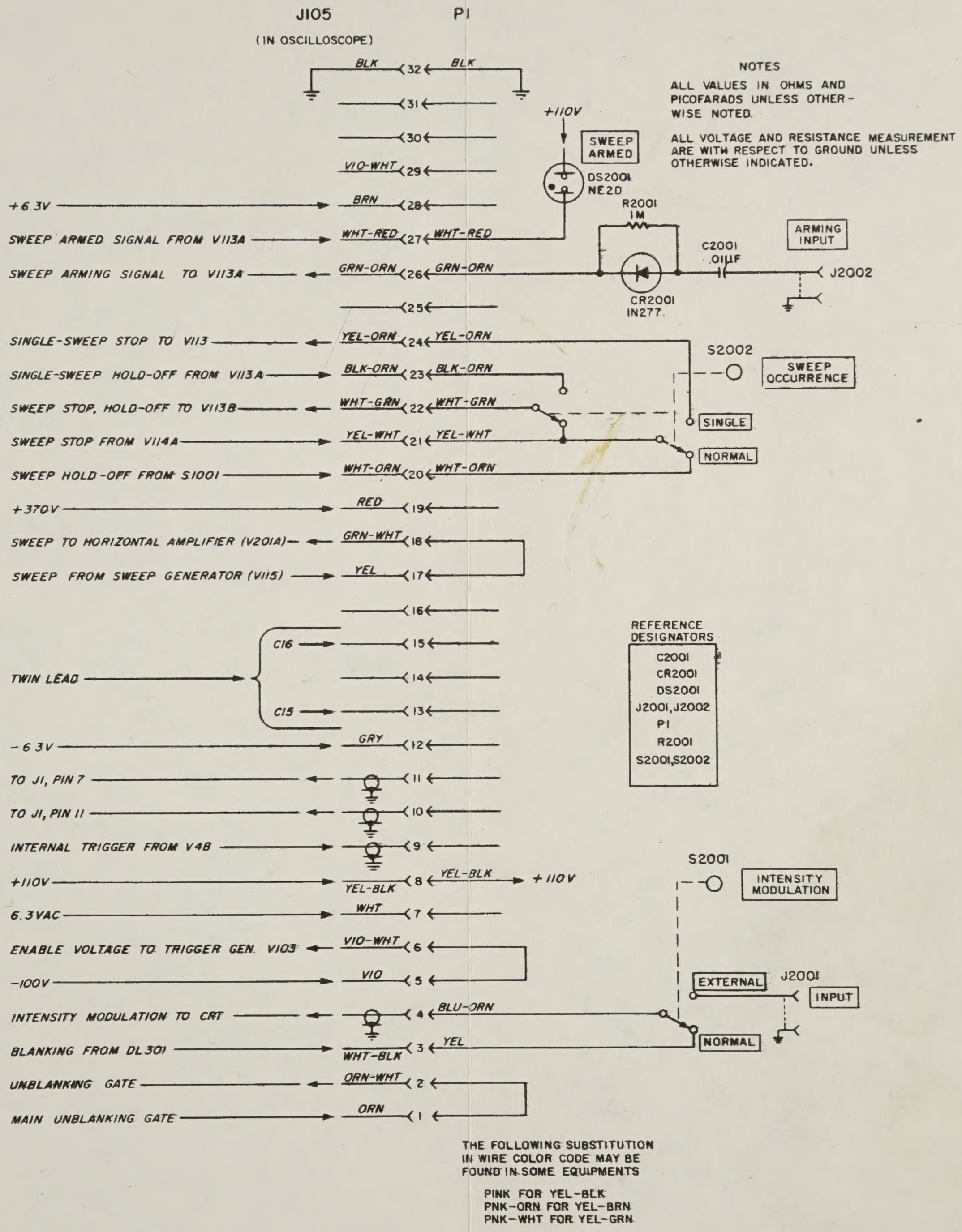
REFERENCE DESIGNATORS

C2001
CR2001
DS2001
J2001, J2002
P1
R2001
S2001, S2002

HE FOLLOWING SUBSTITUTION
I WIRE COLOR CODE MAY BE
OUND IN SOME EQUIPMENTS

PINK FOR YEL-BLK
PNK-ORN FOR YEL-BRN
PNK-WHT FOR YEL-GRN

Plug-in Schematic Diagram


J105
(IN OSCILLOSCOPE)
P1
+6.3V
SWEEP ARMED SIGNAL FROM V113A
SWEEP ARMING SIGNAL TO V113A
SINGLE-SWEEP STOP TO V113
SINGLE-SWEEP HOLD-OFF FROM V113A
SWEEP STOP, HOLD-OFF TO V113B
SWEEP STOP FROM V114A
SWEEP HOLD-OFF FROM S1001
+370V
SWEEP TO HORIZONTAL AMPLIFIER (V201A)
SWEEP FROM SWEEP GENERATOR (V115)
TWIN LEAD
C16
C15
-6.3V
TO J1, PIN 7
TO J1, PIN 11
INTERNAL TRIGGER FROM V4B
+110V
6.3VAC
ENABLE VOLTAGE TO TRIGGER GEN. V103
-100V
INTENSITY MODULATION TO CRT
BLANKING FROM DL301
UNBLANKING GATE
MAIN UNBLANKING GATE
BLK
VIO-WHT
BRN
WHT-RED
GRN-ORN
YEL-ORN
BLK-ORN
WHT-GRN
YEL-WHT
WHT-ORN
RED
GRN-WHT
YEL
GRY
YEL-BLK
WHT
VIO
BLU-ORN
WHT-BLK
ORN-WHT
ORN
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
+110V
SWEEP ARMED
DS2001
NE2D
R2001
1M
C2001
.01μF
CR2001
1N277
ARMING INPUT
J2002
S2002
SWEEP OCCURRENCE
SINGLE
NORMAL
+110V
S2001
INTENSITY MODULATION
EXTERNAL
J2001
INPUT
NORMAL
REFERENCE DESIGNATORS
C2001
CR2001
DS2001
J2001, J2002
P1
R2001
S2001, S2002

NOTES

ALL VALUES IN OHMS AND PICOFARADS UNLESS OTHERWISE NOTED.

ALL VOLTAGE AND RESISTANCE MEASUREMENT ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED.

THE FOLLOWING SUBSTITUTION IN WIRE COLOR CODE MAY BE FOUND IN SOME EQUIPMENTS

PINK FOR YEL-BLK
PNK-ORN FOR YEL-BRN
PNK-WHT FOR YEL-GRN

Figure 6-19 Auxiliary Plug-in Schematic Diagram

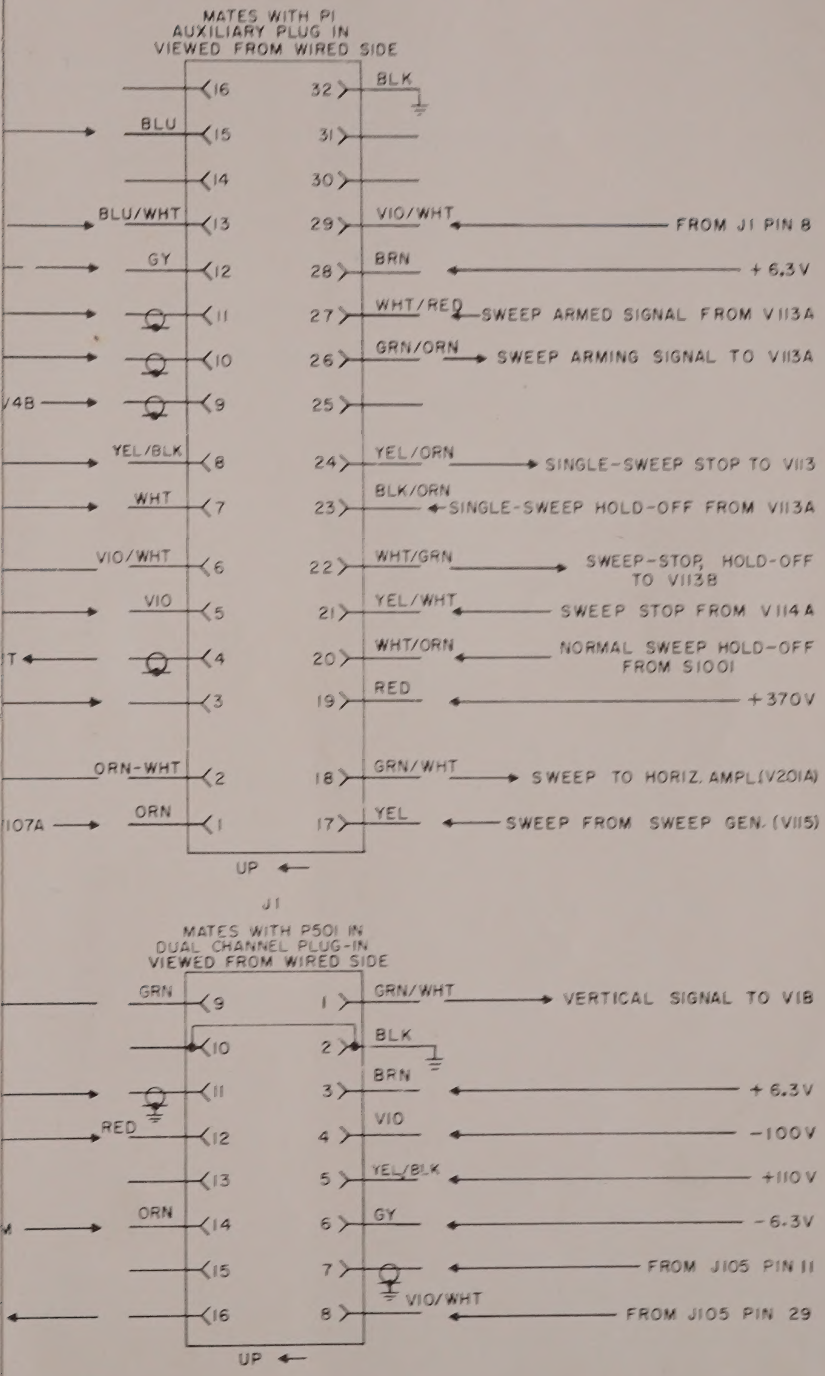
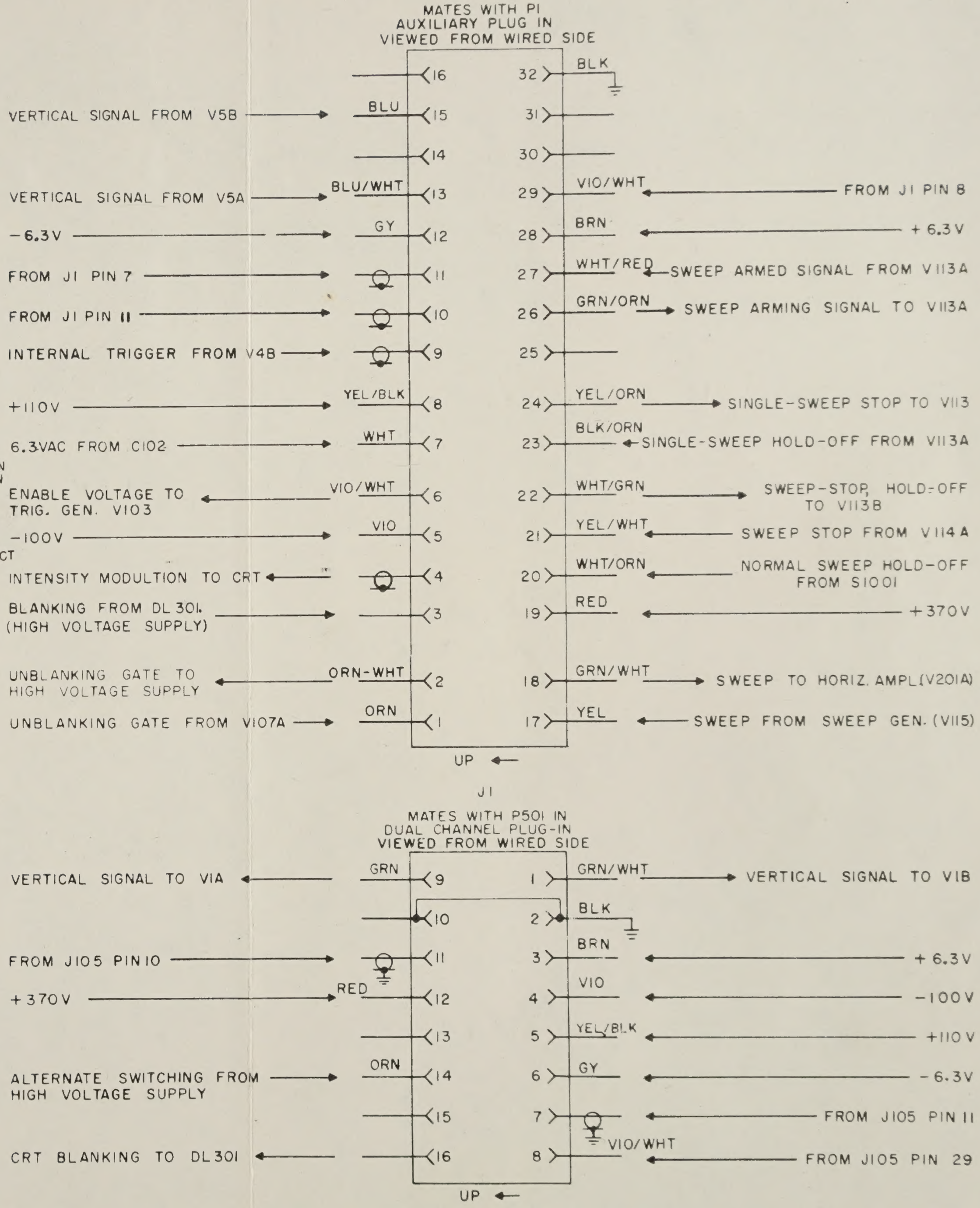

MATES WITH P1
AUXILIARY PLUG IN
VIEWED FROM WIRED SIDE
16
32
BLK
BLU
15
31
14
30
BLU/WHT
13
29
VIO/WHT
FROM J1 PIN 8
GY
12
28
BRN
+ 6.3V
11
27
WHT/RED
SWEEP ARMED SIGNAL FROM V113A
10
26
GRN/ORN
SWEEP ARMING SIGNAL TO V113A
4B
9
25
YEL/BLK
8
24
YEL/ORN
SINGLE-SWEEP STOP TO V113
WHT
7
23
BLK/ORN
SINGLE-SWEEP HOLD-OFF FROM V113A
VIO/WHT
6
22
WHT/GRN
SWEEP-STOP, HOLD-OFF
TO V113B
VIO
5
21
YEL/WHT
SWEEP STOP FROM V114A
T
4
20
WHT/ORN
NORMAL SWEEP HOLD-OFF
FROM S1001
3
19
RED
+370V
ORN-WHT
2
18
GRN/WHT
SWEEP TO HORIZ. AMPL.(V201A)
107A
ORN
1
17
YEL
SWEEP FROM SWEEP GEN. (V115)
UP
J1
MATES WITH P501 IN
DUAL CHANNEL PLUG-IN
VIEWED FROM WIRED SIDE
GRN
9
1
GRN/WHT
VERTICAL SIGNAL TO V1B
10
2
BLK
11
3
BRN
+ 6.3V
RED
12
4
VIO
−100V
13
5
YEL/BLK
+110V
ORN
14
6
GY
−6.3V
15
7
FROM J105 PIN 11
16
8
VIO/WHT
FROM J105 PIN 29
UP

Figure 6-20 Wiring for Plug-in Connectors


MATES WITH PI
AUXILIARY PLUG IN
VIEWED FROM WIRED SIDE
VERTICAL SIGNAL FROM V5B
BLU
VERTICAL SIGNAL FROM V5A
BLU/WHT
-6.3V
GY
FROM J1 PIN 7
FROM J1 PIN 11
INTERNAL TRIGGER FROM V4B
+110V
YEL/BLK
6.3VAC FROM C102
WHT
ENABLE VOLTAGE TO
TRIG. GEN. V103
VIO/WHT
-100V
VIO
INTENSITY MODULTION TO CRT
BLANKING FROM DL 301
(HIGH VOLTAGE SUPPLY)
UNBLANKING GATE TO
HIGH VOLTAGE SUPPLY
ORN-WHT
UNBLANKING GATE FROM V107A
ORN
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
BLK
VIO/WHT
FROM J1 PIN 8
BRN
+ 6.3V
WHT/RED
SWEEP ARMED SIGNAL FROM V113A
GRN/ORN
SWEEP ARMING SIGNAL TO V113A
YEL/ORN
SINGLE-SWEEP STOP TO V113
BLK/ORN
SINGLE-SWEEP HOLD-OFF FROM V113A
WHT/GRN
SWEEP-STOP, HOLD-OFF
TO V113B
YEL/WHT
SWEEP STOP FROM V114 A
WHT/ORN
NORMAL SWEEP HOLD-OFF
FROM S1001
RED
+370V
GRN/WHT
SWEEP TO HORIZ. AMPL(V201A)
YEL
SWEEP FROM SWEEP GEN. (V115)
UP
J1
MATES WITH P501 IN
DUAL CHANNEL PLUG-IN
VIEWED FROM WIRED SIDE
VERTICAL SIGNAL TO V1A
GRN
FROM J105 PIN 10
+370V
RED
ALTERNATE SWITCHING FROM
HIGH VOLTAGE SUPPLY
ORN
CRT BLANKING TO DL301
9
10
11
12
13
14
15
16
1
2
3
4
5
6
7
8
GRN/WHT
VERTICAL SIGNAL TO V1B
BLK
BRN
+ 6.3V
VIO
-100V
YEL/BLK
+110V
GY
- 6.3V
FROM J105 PIN 11
VIO/WHT
FROM J105 PIN 29
UP

THE FOLLOWING SUBSTITUTION IN WIRE COLOR CODE MAY BE FOUND IN SOME EQUIPMENTS.

PINK FOR YEL-BLK
PNK-ORN FOR YEL-BRN
PNK-WHT FOR YEL-GRN

ALL VOLTAGE AND RESISTANCE MEASUREMENTS ARE WITH RESPECT TO GROUND UNLESS OTHERWISE INDICATED

Figure 6-20 Wiring for Plug-in Connectors

7-1. INTRODUCTION

Reference designations are assigned to identify all maintenance parts of the AN/USM-105A. They are used for marking the instrument (adjacent to the part they identify) and are included on the schematics, wiring diagrams, and the parts list, table 7-1. The letter prefix of a reference designation indicates the kind of part-resistor, capacitor, electron tube, etc. The number differentiates between parts in the same group. Sockets associated with electron tubes, fuses, and like items include the reference designation of the associated part and a prefix X.

A series of numbers is assigned for each major section in the AN/USM-105A. These numbers are associated with the following major sections:

Main Vertical Amplifier	1-99
Sweep Circuits	100-199
Horizontal Amplifier	200-299
High Voltage Power Supply	300-399
Low Voltage Power Supply	400-499
Dual Trace Preamplifier (Plug-In)	500-599
Dual Trace Attenuator	1500-1599
Sweep Time Switch	1000-1099
Auxiliary Plug-In	2000-2099

7-2. MAINTENANCE PARTS LIST

Table 7-1 lists all maintenance parts for the AN/USM-105A. The table includes a functional location for parts. The physical location of parts is illustrated in Sections 3, 5 and 6. Manufacturer and type or part number are given for items which have no military designation. Manufacturers addresses are listed in table 7-2.

TABLE 7-1. MAINTENANCE PARTS LIST

Oscilloscope OS-82A/USM-105A

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
A1		BOARD, ETCHED CIRCUIT, includes: C2, C3, C4, C5, C8, C9, C10, C11, C12, C13, CR1, CR2, L1, L2, L3, L4, L5, L6, L7, L8, L9, L10, L31, R1, R2, R3, R4, R5, R6, R7, R8, R9, R11, R12, R13, R14, R15, R16, R17, R18, R22, R23, R55, R56, R57, R311, V1, V2, V3, V4, XV1, XV2, XV3, XV4 (28569 stk. no. 2420-565)	Main Vertical Amplifier Board, Figure 5-6.
A2		BOARD, ETCHED CIRCUIT, includes: C6, C7, C14, L11, L12, L13, L14, L19, L23, L24, R24, R25, R27, R30, R32, R34, R35, R36, R40, R47, R69, R70, V5, V6, V7, XV5, XV6, XV7 (28569 stk. no. 2420-566)	Main Vertical Amplifier Driver Board, Figure 5-6.
A3		BOARD, ETCHED CIRCUIT, includes: L15, L16, L17, L18, L21, L22, L25, L26, L27, L28, L29, L30, R45, R52, V8, V9, V10, V11, XV8, XV9, XV10, XV11 (28569 stk. no. 2420-567)	Main Vertical Amplifier Output Borad, Figure 5-6.
A4		ASSEMBLY, TEST PROD	
A5		Same as A4	
A6		BOARD, ETCHED CIRCUIT, includes: C15, C16, R61, R62, R63, R64, R65, R66, R67, R68 (28569 stk. no. 2420-575)	Main Vertical Amplifier High Frequency Compensating Network, Figure 5-6.
A100		SWITCH ASSEMBLY, REPAIRABLE, consists of rotary switch S102 with the following circuit components: C103, C104, R103, R104, R105, R106, S102 (28569 stk no. 19915-586.	Trigger Slope Switch, Figure 3-1.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
A101		BOARD, ETCHED CIRCUIT, includes: C102, C105, C106, C107, C108, C109, C110, C114, C115, C116, C117, C118, C119, C121, C122, C123, C124, C132, C133, C134, C135, C136, C137, C139, C140, C141, C142, C143, CR101, CR102, CR103, CR104, L101, L102, L103, R107, R108, R109, R110, R111, R112, R113, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R125, R130, R131, R132, R133, R134, R135, R136, R137, R138, R139, R140, R141, R142, R143, R144, R145, R146, R147, R148, R149, R150, R151, R152, R153, R154, R155, R156, R157, R158, R165, R167, R168, R169, R170, R171, R172, R173, R174, R175, R176, R177, R179, R180, R181, R182, R183, R186, R187, R188, R189, R190, V101, V102, V103, V104, V105, V106, V107, V109, V110, V111, V113, V114, V115, V116, XV101, XV102, XV103, XV104, XV105, XV107, XV109, XV113, XV114, XV115 (28569 stk. no. 2420-564)	Sweep Generator Board, Figure 5-7
A102		Not Assigned.	
A103		SWITCH ASSEMBLY, REPAIRABLE, consists of rotary switch S101 with the following circuit components: C101, C130, R101, R102, R161, R162, R164, S101, S103 (28569 stk. no. 19915-587)	Trigger Source Switch, Figure 3-1.
A200		SWITCH ASSEMBLY, REPAIRABLE, consists of rotary switch S202 with the following circuit components: R210, R1023, R209, R233, R234, R235, R236, R237, R238, R239, R240, R241, R242 (28569 stk. no. 19915-583).	Horizontal Display Switch, Figure 3-1.
A201		BOARD, ETCHED CIRCUIT, includes: C201, C204, C205, C207, R201, R202, R203, R204, R212, R213, (28569 stk. no. 2420-570)	Horizontal Preamplifier Board, Figure 3-1.
A202		BOARD, ETCHED CIRCUIT, includes: C211, C212, C213, C214, C215, C216, C222, L201, L202, R244, R245, R246, R247, R248, R249, R250, R251, R252, R253, R254, R255, R256, R257, R258, R259, R260, R264, R266, R267, R268, R269, R271, R272, R273, R274, R275, R276, R278, Q201, Q202, V203, V204, V205, V206, V207, XV203, XV204, XV205, XV206, XV207 (28569 stk. no. 2420-568)	Horizontal Preamplifier Board, Figure 5-6.
A203		BOARD, ETCHED CIRCUIT, includes: C206, C221, R205, R206, R207, R208, R214, R215, R217, R218, R221, R222, R224, R277, V201, V202, XV201, XV202, (28569 stk. no. 2420-569)	Main Horizontal Amplifier Board, Figure 5-7
A300		SWITCH ASSEMBLY, REPAIRABLE, consists of rotary switch S302 with the following resistors: R343 through R352 (28569 stk. no. 19915-585)	Calibrator Switch, Figure 3-1
A301		BOARD, ETCHED CIRCUIT, includes: C301, C303, C304, C305, C316, C317, L301, L302, R301, R302, R303, R304, R305, R307, R318, R319, R320, R324, R335, R336, R337, R338, R339, R340, R342, V301, V302, V306, V307, V308, V309, XV301, XV302, XV306, XV307 (28569 stk. no. 2420-572)	High Voltage Power Supply Board, Figure 5-6
A302		BOARD, ETCHED CIRCUIT, includes: C302, C307, C308, C310, C311, C312, R308, R310, R313, R322, R323, R325, R327, R328, R329, R330, R331, (28569 stk. no. 2420-573)	High Voltage Capacitor Board, Figure 5-6
A401		BOARD, ETCHED CIRCUIT, includes: C404, C405, C406, C407, CR401 through CR412 (28569 stk. no. 2420-574)	Low Voltage Power Supply Rectifier Board, Figure 5-7

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
A402		BOARD, ETCHED CIRCUIT, includes: C409, C412, C417, C418, C419, C426, CR413, CR416, Q401, Q402, Q406, Q407, Q408, Q410, Q411, Q412, Q414, Q415, R408, R409, R410, R412, R413, R415, R416, R417, R425, R426, R427, R428, R430, R432, R433, R434, R435, R443, R445, R446, R447, R448, R449, R450, R451, R459, R461, R462, R463, V401, XV401 (28569 stk. no. 2420-571)	Low Voltage Power Supply Regulator Board, Figure 5-7
AA1000		SWITCH ASSEMBLY, REPAIRABLE, consists of rotary switch S1001 with the following circuit components: C1001, C1002, C1003, C1004, C1007, C1008, C1009, C1010, C1011, C1012, C1013, C1014, C1015, C1016, R1001, R1005, R1006, R1007, R1011, R1012, R1013, R1014, R1015, R1016, R1017, R1018, R1019, R1020, R1021 (28569 stk. no. 19915-584)	Sweep Time Switch, Figure 3-1
B401		MOTOR, DIRECT CURRENT, 18v, 1550 RPM, 1 amp, continuous duty at 25°c per MIL-T-945 (62119 #8-088)	Fan Motor, Figure 5-8
B401A		BLADE, FAN, ccw rotation facing air discharge side, five blades, rubber-mounted hub	
C1		CAPACITOR, FIXED MICA, 100 uuf, 5%, 300v, Type CM15C101JN3 per MIL-C-5B.	Bypass capacitor for V2. Mounted on Vert. Gain Adj. control, Figure 6-2
C2		CAPACITOR, FIXED CERAMIC, .02 uf ±20%, 500 VDC, (72982 #841-010W5R203M)	Coupling capacitor for V4A, Figure 5-11
C3		Same as C2	Coupling capacitor for V4B, Figure 5-11
C4		Same as C2	Coupling Capacitor for V4B cathode, Figure 5-11.
C5		CAPACITOR, FIXED CERAMIC, 10 uuf, ±.5 uuf, 500v (72982 p/n 301-651C0G100D)	Bypass capacitor for V3B, Figure 5-11
C6		CAPACITOR, FIXED CERAMIC, .01 uf, 20%, 500v, disc type, type CK63AW103M per MIL-C-11015B	Bypass capacitor for V5 bias, Figure 5-12.
C7		Same as C6	Bypass capacitor for V6 plate supply, Figure 5-12.
C8		Same as C2	Bypass capacitor for V2 plate supply, Figure 5-11.
C9		Same as C2	Bypass capacitor for V2 plate supply, Figure 5-11.
C10		Same as C6	Bypass capacitor for V1B plate supply, Figure 5-11.
C11		Same as C6	Bypass capacitor for V4 plate supply, Figure 5-11
C12		Same as C6	Bypass capacitor for V4B cathode supply, Figure 5-11
C13		Same as C6	Bypass capacitor for V3 plate supply, Figure 5-11
C14		Same as C6	Bypass capacitor for V8, V9, V10 and V11 plate supply, Figure 5-12

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C15		CAPACITOR, VARIABLE CERAMIC, 5-20 uuf, 500v type CV11B200 per MIL-C-81A	High frequency compensating adjustment, Figure 5-14
C16		Same as C15	High frequency compensating adjustment, Figure 5-14
C17-C100		Not Assigned	
C101		Same as C6	Coupling capacitor for trigger input, Figure 5-17
C102		CAPACITOR, FIXED CERAMIC, .0047 uf, 20%, 500v, type CK62AW472M per MIL-C-11015B	Coupling capacitor for trigger input, Figure 5-16
C103		CAPACITOR, FIXED CERAMIC, .001 uf, 10%, 500v, disc type, type CK62BX102K per MIL-C-11015B	Coupling capacitor for V101, Figure 5-15
C104		Same as C6	Decoupling capacitor for trigger reference level, Figure 5-15
C105		CAPACITOR, FIXED, MICA, 240 uuf, 5%, 300v, type CM15D241JN3 per MIL-C-5B	Bypass, capacitor for V101 cathode, Figure 5-16
C106		Same as C103	Coupling capacitor for V103A, Figure 5-16
C107		CAPACITOR, FIXED, MICA, 33 uuf, 5%, 300v, type CM15C330JN3 per MIL-C-5B	Coupling capacitor for V104A, Figure 5-16
C108		CAPACITOR, FIXED, MICA, 75 uuf, 5%, 300v, type CM15C750JN3 per MIL-C-5B	Clamp capacitor for V103 cathode, Figure 5-16
C109		CAPACITOR, FIXED, MICA, 47 uuf, 5%, 300v, type CM15C470JN3 per MIL-C-5B	Coupling capacitor for V104B, Figure 5-16
C110		CAPACITOR, FIXED, CERAMIC, 2.2 uuf ±.25 uuf, 500v, tubular type, (72982 #301-651C0J229C)	Feedback capacitor for V103, Figure 5-16
C111-C113		Not Assigned	
C114		CAPACITOR, FIXED, MICA, 100 uuf, 10%, 500v, type CM20B101KN3 per MIL-C-5B	Coupling capacitor for V105A, Figure 5-16
C115		Same as C2	Coupling capacitor for V107A, Figure 5-16
C116		Same as C6	Coupling capacitor for V107B, Figure 5-16
C117		CAPACITOR, FIXED, CERAMIC, 3.3 uuf ±.25 uuf, 500v, tubular type (72982 #301-651C0J339C)	Coupling capacitor for V104B, Figure 5-16
C118		Same as C6	Bypass capacitor for V104 cathode, Figure 5-16
C119		CAPACITOR, FIXED, MICA, 220 uuf, 10%, 500v, type CM20B221KN3 per MIL-C-5B	Decoupling capacitor for V105B grid, Figure 5-16
C120		Not Assigned	
C121		CAPACITOR, VARIABLE, CERAMIC, 1.5-7 uuf, 500v, type CV11A070 per MIL-C-81A	Timing capacitor for V109, Figure 5-16
C122		Same as C6	Decoupling capacitor for V109 screen, Figure 5-16
C123		Same as C103	Coupling capacitor for V115, Figure 5-16
C124		CAPACITOR, FIXED, MICA, 68 uuf, 5%, 300v, (76433 #MCM15D680J)	Bypass capacitor for V109 plate, Figure 5-16

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C125- C129		Not Assigned	
C130		Same as C103	Bypass capacitor for S103, Figure 5-17
C131		Not Assigned	
C132		CAPACITOR, FIXED, MICA, 390 uuf, 5%, 300v, type CM15D391JN3 per MIL-C-5B	Bypass capacitor for arming input, Figure 5-16
C133		Same as C124	Coupling capacitor for V113B, Figure 5-16
C134		CAPACITOR, FIXED, MICA, 10 uuf, 5%, 300v, type CM20B100KN3 per MIL-C-5B.	Coupling capacitor for V114 grid, Figure 5-16
C135		Same as C6	Coupling capacitor for V114B, Figure 5-16
C136		Same as C103	Bypass capacitor for V113B cathode, Figure 5-16
C137		Same as C2	Decoupling capacitor for V107 plate supply, Figure 5-16
C138		Not Assigned	
C139		Same as C2	Decoupling capacitor for sweep generator voltage supply, Figure 5-16
C140		Same as C6	Decoupling capacitor for sweep generator voltage supply, Figure 5-16
C141		Same as C6	Decoupling capacitor for sweep generator voltage supply, Figure 5-16
C142		Same as C6	Decoupling capacitor for sweep generator voltage supply, Figure 5-16
C143		Same as C109	Sweep hold-off capacitor at V114A cathode, Figure 5-16
C144- C200		Not Assigned	
C201		CAPACITOR, VARIABLE, CERAMIC, 7-45 uuf, 500v, type CV11C450 per MIL-C-81A	Compensating capacitor for sweep gain, Figure 5-19
C202		CAPACITOR, FIXED, PLASTIC, plastic insulated case, 0.1 uf, 20%, 600v, (01295 type 27)	Coupling capacitor for horizontal input, Mounted on S201
C203		Not Assigned	
C204		Same as C121	Compensating capacitor for horizontal input attenuator, Figure 5-19
C205		Same as C109	Compensating capacitor for horizontal input attenuator, Figure 5-19

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C206		Same as C6	Coupling capacitor for V201B, Figure 5-21
C207		Same as C201	Compensating capacitor for horizontal gain adjust R212, Figure 5-19
C208- C210		Not Assigned	
C211		Same as C201	Low frequency compensating capacitor for main horizontal amplifier, Figure 5-20
C212		CAPACITOR, VARIABLE, AIR DIELECTRIC, clip type, O-1 uuf, (28569 #19290-60) or (28480 #160A-7A)	High frequency compensating capacitor for main horizontal amplifier, Figure 5-20.
C213		Same as C201	Low frequency compensating capacitor for main horizontal amplifier, Figure 5-20
C214		Same as C212	High frequency compensating capacitor for main horizontal amplifier, Figure 5-20
C215		CAPACITOR, FIXED, PAPER, metal case, 0.1 uf, 10%, 400v, type CP05A1KE104K3 per MIL-C-25C	Bypass capacitor for V207 cathode, Figure 5-20
C216		Same as C15	Coupling capacitor for V207 input, Figure 5-20
C217- C220		Not Assigned	
C221		Same as C2	Decoupling capacitor for 110v supply to horizontal amplifier, Figure 5-21
C222		CAPACITOR, FIXED, PAPER, insulated case, 0.1 uf, 10%, 600v, type CP09A1KF104K3 per MIL-C-25C	Decoupling capacitor for 370 v supply to horizontal amplifier, Figure 5-20
C223- C300		Not Assigned	
C301		Same as C2	Bypass capacitor for V301A, Figure 5-23
C302		CAPACITOR, FIXED, PAPER, molded plastic case, 0.0015 uf, 20% 6000v, (56289 #184P152060)	Bypass capacitor for R309, Figure 5-24
C303		CAPACITOR, FIXED, CERAMIC, 2200 uuf, 10%, 500v, disc type, type CK63BX222K per MIL-C-11015B	Bypass capacitor for V302 grid, Figure 5-23
C304		CAPACITOR, FIXED, MICA, 470 uuf, 10%, 500v, type CM20B471KN3 per MIL-C-5B	Coupling capacitor for V302 grid, Figure 5-23
C305		Same as C222	Bypass capacitor for V302 supply, Figure 5-23

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C306		CAPACITOR, FIXED, PAPER, molded plastic case, .0047 uf, 20%, 6000v, (56289 #184P472060)	Filter capacitor for V303, Figure 6-6
C307		Same as C306	Filter capacitor for V303, Figure 5-24
C308		Same as C306	Coupling capacitor for intensity modulation to V305, Figure 5-24
C309		Same as C306	Filter capacitor for V304, Figure 6-6
C310		Same as C306	Coupling capacitor for V305 grid, Figure 5-24
C311		Same as C306	Coupling capacitor for V305 grid, Figure 5-24
C312		CAPACITOR, FIXED, MICA, 22 uuf, 10%, 500v, type CM20B220KN3 per MIL-C-5B	Coupling capacitor for blanking to V305, Figure 5-24
C313		Same as C6	Bypass capacitor for astigmatism control R312. Located on R312
C314		Same as C303	Coupling capacitor for transformer T301. Located on T301.
C315		Not Assigned	
C316		CAPACITOR, FIXED, MICA, 27 uuf, 5%, 300v, type CM15C270JN3 per MIL-C-5B	Coupling capacitor for V306B, Figure 5-23
C317		Same as C316	Coupling capacitor for V306A, Figure 5-23
C318		CAPACITOR, FIXED, MICA, 560 uuf, 5%, 500v, type CM30D561JN3 per MIL-C-5B	Bypass capacitor for R354. Located on E302
C319- C400		Not Assigned	
C401		CAPACITOR, FIXED, ELECTROLYTIC, 120 uf, 450v, -20°c to +85°c, metal case, (56289 #D29405)	Filter capacitor for +370 volt supply, Figure 5-7
C402		CAPACITOR, FIXED, PAPER, 1 uf, 10%. 400v, type CP05A1KE105K3 per MIL-C-25C	Bypass capacitor for Q406 base, Figure 5-10
C403		CAPACITOR, FIXED, ELECTROLYTIC, 45 uf, 450v, -20°c to +85°c, metal case, (56289 #D29401)	Filter capacitor for +370 volt supply, Figure 5-7
C404		Same as C2	Bypass capacitor for CR401, CR402, CR403 CR404, Figure 5-25
C405		Same as C2	Bypass capacitor for CR405, CR406, CR407, CR408, Figure 5-25
C406		Same as C2	Bypass capacitor for CR409, CR410, CR411, CR412, Figure 5-25
C407		Same as C215	Bypass capacitor for T401, 43 volt winding, Figure 5-25

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C408		Same as C401	Filter capacitor for +110 v supply, Figure 5-7
C409		Same as C202	Bypass capacitor for Q408 base, Figure 5-26
C410		Same as C402	Bypass capacitor for Q401 base, Figure 5-10
C411		CAPACITOR, FIXED, ELECTROLYTIC, 50 uf, 300v, -20°c to +85°c, metal case, (56289 #D29402)	Filter capacitor for +110 volt supply, Figure 5-7
C412		Same as C202	Bypass capacitor for Q405 base, Figure 5-26
C413		Not Assigned	
C414		Not Assigned	
C415		Not Assigned	
C416		Same as C401	Filter capacitor for -100 volt supply, Figure 5-7
C417		Same as C202	Bypass capacitor for Q412 base, Figure 5-26
C418		Same as C6	Bypass capacitor for Q410 base, Figure 5-26
C419		CAPACITOR, FIXED, ELECTROLYTIC, 20 uf, +100 -15%, Type CL25BJ80UP3 (existing stock of 56289 #40D181A2 may be used)	Bypass capacitor for Q411 base, Figure 5-26
C420		Same as C411	Filter capacitor for -100v supply, Figure 5-7
C421-C424		Not Assigned	
C425		CAPACITOR, FIXED, ELECTROLYTIC, 6000 uf, 35v, (56289 #32D315)	Filter capacitor for 6.3v supply, Figure 5-7
C426		Same as C215	Bypass capacitor for Q415 base, Figure 5-26
C427-C499		Not Assigned	
C1000		Not Assigned	
C1001		CAPACITOR, FIXED, PAPER, 0.47 uf, 10%, 200v, type CP09A1KC474K3 per MIL-C-25C	Holdoff timing capacitor on S1001, Figure 5-27
C1002		CAPACITOR, FIXED, PAPER, 0.047 uf, 10%, 200v, type CP09A1KC473K3 per MIL-C-25C	Holdoff timing capacitor on S1001, Figure 5-27
C1003		CAPACITOR, FIXED, MICA, 0.0047 uf, 5%, 500v, type CM35D472JN3 per MIL-C-5B	Holdoff timing capacitor on S1001, Figure 5-27
C1004		Same as C304	Holdoff timing capacitor on S1001, Figure 5-27
C1005		Not Assigned	
C1006		CAPACITOR, FIXED, PLASTIC, 1.0 uf, 5%, 200v, type CQO5A1VC105J per MIL-C-19978A	Timing capacitor for sweep time on S1001, Figure 5-27

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1007		CAPACITOR, FIXED, PLASTIC, 0.1 uf, 5%, 200v, type CQO5A1VC104J per MIL-C-19978A	Timing capacitor for sweep time on S1001, Figure 5-27
C1008		CAPACITOR, FIXED, PLASTIC, 0.01 uf, 5%, 200v, type CQO5A1VC103J per MIL-C-19978A	Timing capacitor for sweep time on S1001, Figure 5-27
C1009		CAPACITOR, FIXED, MICA, 1000 uuf, 2%, 300v, type CM20D102GN3 per MIL-C-5B	Timing capacitor for sweep time on S1001, Figure 5-27
C1010		CAPACITOR, VARIABLE, CERAMIC, 7-45 uuf, 500v, N500 temp. coef, CV11C450 except straighten terminals	Timing capacitor for sweep time on S1001, Figure 5-27
C1011		CAPACITOR, FIXED, MICA, 82 uuf, 5%, 300v, type CM15C820JN3 per MIL-C-5B	Timing capacitor for sweep time on S1001, Figure 5-27
C1012		Same as C1010	Timing capacitor for sweep time on S1001, Figure 5-27
C1013		CAPACITOR, FIXED, MICA, 68 uuf, 5%, 300v. type CM15C680JN3 per MIL-C-5B	Timing capacitor for sweep time on S1001, Figure 5-27
C1014		Same as C1010	Timing capacitor for sweep time on S1001, Figure 5-27
C1015		CAPACITOR, FIXED, MICA, 22 uuf, 5%, 300v, type CM15C220JN3 per MIL-C-5B	Timing capacitor for sweep time on S1001, Figure 5-27
C1016		Same as C1010	Timing capacitor for sweep time on S1001, Figure 5-27
C1017- C1499		Not Assigned	
CR1		SEMICONDUCTOR DEVICE, DIODE, Zener diode 15v ± 1v at 25°c +.075% 1° temp. coef., (80211 #1.5M15Z5) (existing stk. of 28480 #G-29-G-4 may be used)	Coupling diode for V3A, Figure 5-11
CR2		Same as CR1	Coupling diode for V3B, Figure 5-11
CR3- CR100		Not Assigned	
CR101		SEMICONDUCTOR DEVICE, DIODE, 1N916A (existing stk of 28480 #G-29F-1 may be used)	Clamp diode for V104A plate, Figure 5-16
CR102		Same as CR101	Bypass diode for V104A grid, Figure 5-16
CR103		SEMICONDUCTOR DEVICE, DIODE, silicon zener, (01295#IN754A)	Reference diode for V104B plate, Figure 5-16
CR104		Same as CR101	Switch diode for V109 grid, Figure 5-16
CR105- CR400		Not Assigned	
CR401		RECTIFIER, 1N1566A silicon junction diode	Rectifier for +370v supply, Figure 5-25
CR402		Same as CR401	Rectifier for +370v supply, Figure 5-25

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
CR403		Same as CR401	Rectifier for +370v supply, Figure 5-25
CR404		Same as CR401	Rectifier for +370v supply, Figure 5-25
CR405		Same as CR401	Rectifier for +110v supply, Figure 5-25
CR406		Same as CR401	Rectifier for +110v supply, Figure 5-25
CR407		Same as CR401	Rectifier for +110v supply, Figure 5-25
CR408		Same as CR401	Rectifier for +110v supply, Figure 5-25
CR409		Same as CR401	Rectifier for -100v supply, Figure 5-25
CR410		Same as CR401	Rectifier for -100v supply Figure 5-25
CR411		Same as CR401	Rectifier for -100v supply, Figure 5-25
CR412		Same as CR401	Rectifier for -100v supply, Figure 5-25
CR413		Same as CR103	Reference diode for Q411 collector, Figure 5-26
CR414		SEMICONDUCTOR DEVICE, DIODE, JAN 1N1202 (JAN 1200 may be used)	Rectifier for 6.3v supply, Figure 5-7
CR415		Same as CR414	Rectifier for 6.3v supply, Figure 5-7
CR416		Same as CR103	Reference diode for Q414 emitter, Figure 5-26
CR417- CR499		Not Assigned	
DL1- DL2		CABLE, RADIO FREQUENCY, matched pair, 0.25 usec delay each, paired within 1% (5% o/a) (28569 #3030-158) (existing stk of 28480 #160A-16A may be used)	Delay line Main vertical amplifier Figure 5-12
DL3- DL300		Not Assigned	
DL301		CABLE ASSEMBLY, RADIO FREQUENCY, 0.25 usec delay (5% o/a) (28569 #3030-159) (existing stk of 28480 #106A-16A(N) may be used)	Delay line chopped blanking voltage, Figure 5-9
DS401		LAMP, GLOW, MS25252-NE2D per MIL-L-15098B, single contact midget flange base	Power on lamp, Figure 3-1
DS402		LAMP, GLOW, (93519 type NE-76), T-2 clear bulb (existing stk of type NE2 may be used)	Over heat indicator, Figure 5-8
DS403- DS406		LAMP, INCANDESCENT, (93519 type 47), 6-8 volt, .15 amp, miniature bayonet base	Scale illumination lamps, Figure 5-6
DS407- DS1000		Not Assigned	
DS1001	*	Same as DS403	Sweep uncal indicator, Figure 3-1
F401		FUSE, CARTRIDGE, 8 Amp, 250 volt, type FO3G8ROOA per MIL-F-15160C, silver pl. per MS90079-4-1	Power line fuse, Figure 5-8
F402		Same as F401	Power line fuse, Figure 5-8
F403		FUSE, CARTRIDGE, .5 Amp, 250 volt type F02GR500A per MIL-F-15160C, silver pl. per MS90078-7-1	+307v power supply fuse, Figure 5-8

* For REF. DESIG. E1 through E308 and J1 through J201 refer to Page 7-31.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
F404		FUSE, CARTRIDGE, 1 Amp, 250 volt, type F02G1R00A per MIL-F-15160C, silver pl. per MS90078-9-1	+110v power supply fuse, Figure 5-7
F405		FUSE, CARTRIDGE, .75 Amp, 250 volt, type F02GR750A per MIL-F-15160C, silver pl. per MS90078-8-1	-100v power supply fuse, Figure 5-7
F406		FUSE CARTRIDGE, 10 Amp, 32 volt, SLO-BLO, (71400 MDA-10)	6.3v power supply fuse, Figure 5-8
FL401		FILTER, LINE, 5 Amp, 115 VAC, 50 to 400 cps or 230 VAC, 60 cps (26985-6265-16) or 28480 #9110-0030-9)	Line filter
L1		COIL, RF, 0.33 uh, 5%, 200 ma dc, phenolic coil form, molded phenolic body, axial leads, (95265 #NE-0.33-P±5%)	Coupling Coil for V1A, Figure 5-11
L2		Same as L1	Coupling Coil for V1B, Figure 5-11
L3		COIL, RF, 3.9 uh ± 5%, 100 ma dc, phenolic coil form, molded phenolic body, axial leads, (95265 #QB-3.9-P±5%)	Peaking Coil for V2A, Figure 5-11
L4		COIL, RF, 6.8 uh, 10%, 100 ma dc, phenolic coil form, molded phenolic body, axial wire leads, (95265 #QA-6.8-P)	Peaking Coil for V2A, Figure 5-11
L5		BEAD, manganese zinc ferride shielding bead, 0.047 in. id x .138 in. od x .118 in. lg., (02114 #T255T118E1-3B)	Parasitic Suppressor for V3A, Figure 5-11
L6		Same as L3	Peaking Coil for V2B, Figure 5-11
L7		Same as L4	Peaking Coil for V2B, Figure 5-11
L8		Same as L5	Parasitic Suppressor for V3B, Figure 5-11
L9		Same as L5	Parasitic Suppressor for V4A, Figure 5-11
L10		Same as L5	Parasitic Suppressor for V4B, Figure 5-11
L11		Same as L5	Parasitic Suppressor for V5A, Figure 5-12
L12		COIL, RF, 5.6 uh, 10%, 100 ma dc, phenolic coil form, molded phenolic body, (95265 #QA-5.6-P)	Peaking Coil for V5A, Figure 5-12
L13		Same as L12	Peaking Coil for V5B, Figure 5-12
L14		Same as L5	Parasitic Suppressor for V5B, Figure 5-12
L15		COIL, RF, 0.18 uh, 10%, 200 ma dc, molded phenolic body, phenolic coil form, (95265 #NB-0.18-P, 10%)	Peaking Coil for V6, Figure 5-13
L16		Same as L15	Peaking Coil for V7, Figure 5-13
L17		Same as L5	Parasitic Suppressor for V8, Figure 5-13
L18		Same as L5	Parasitic Suppressor for V10, Figure 5-13
L19		COIL, RF, 2.2 uh, 5%, 100 ma dc, molded phenolic body, phenolic coil form (95265 #NA-2.2-P±5%)	Peaking Coil for V8, V9, Figure 5-12
L20		Same as L4	Peaking Coil for V8, V9, Figure 5-6
L21		Same as L5	Parasitic Suppressor for V8, Figure 5-13

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L22		Same as L5	Parasitic Suppressor for V10, Figure 5-13
L23		Same as L4	Peaking Coil for V10, V11, Figure 5-12
L24		Same as L19	Peaking Coil for V10, V11, Figure 5-12
L25		Same as L5	Parasitic Suppressor For V9, Figure 5-13
L26		Same as L5	Parasitic Suppressor for V9, Figure 5-13
L27		Same as L5	Parasitic Suppressor for V11, Figure 5-13
L28		Same as L5	Parasitic Suppressor for V11, Figure 5-13
L29		COIL, RF, 10 uh, 10%, 200 ma dc, phenolic coil form, molded phenolic body, (95265 #RB-10-P)	Peaking Coil for V8, V9, Figure 5-13
L30		Same as L29	Peaking Coil for V10, V11, Figure 5-13
L31		COIL, RF, 5000 uh ±10%, 100 ma dc, iron core form, molded phenolic body, (95265 #SA-5000-I)	Decoupling Coil for +88 volts to V2, Figure 5-11
L32- L100		Not Assigned	
L101		Same as L19	Peaking Coil for V103A, Figure 5-16
L102		COIL, RF, 22 uh, 10%, 200 ma dc, type MS75008-19 per MIL-C-15305B	Peaking Coil for V103B, Figure 5-16
L103		Same as L102	Peaking Coil for V104A, Figure 5-16
L104- L200		Not Assigned	
L201		COIL, RF, 5500 uh, 10%, 200 ma type MS75008-19 per MIL-C-15305B (existing stk of 95265 #TB-5500-I may be used)	Peaking Coil for V204, Figure 5-20
L202		Same as L201	Peaking Coil for V205, Figure 5-20
L203- L300		Not Assigned	
L301		Same as L31	Choke Coil for V302, Figure 5-23
L302		COIL, RF, 270 uh, 10%, 200 ma, type MS16223-10 per MIL-C-15305B	Peaking Coil for V302, Figure 5-23
L303- L401		Not Assigned	
L402		INDUCTOR, CHOKE, 250mh, 0.900 Amp DC (28569 # 3250-86) (existing stk of 28480 #9110-0037-9 may be used)	Filter for +110v supply, Figure 5-8
L403		REACTOR, CHOKE, 70mh, 0.5 Amp DC (28569 #3250-87) (existing stk of 28480 #9110-0029-9 may be used)	Filter for +110v supply, Figure 5-7
L404		Same as L402	Filter for -100v supply, Figure 5-8
L405		Same as L403	Filter for -100v supply, Figure 5-7
L406		REACTOR, CHOKE, 10mh, 0.5 Amp DC (28569 #3250-88) (existing stk of 28480 #9110-0029-9 may be used)	Filter for 6.3v supply, Figure 5-8

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L407-L499		Not Assigned	
P401		CONNECTOR PLUG, MS3106E-14S-7S	Part of W401
P402		CONNECTOR PLUG, NUP121M	Part of W401
Q201		TRANSISTOR, Amprex 2N2084	Differential Amp. in Horizontal Amp, Figure 5-20
Q202		Same as Q201	Differential Amp. in Horizontal Amp, Figure 5-20
Q203-Q 400		Not Assigned	
Q401		TRANSISTOR, 2N652A, germanium PNP junction type (JAN 2N652A) (existing stk of type 2N526 may be used)	Differential Amplifier for +370v supply,
Q402		Same as Q401	Differential Amplifier for +370v supply, Figure 5-26
Q403		TRANSISTOR, 2N457	Series Regulator for +370v supply, Figure 5-10
Q404		Same as Q403	Series Regulator for +370v supply, Figure 5-10
Q405		Same as Q403	Series Regulator for +370v supply, Figure 5-10
Q406		Same as Q401	Differential Amplifier for +110v supply, Figure 5-26
Q407		Same as Q401	Differential Amplifier for +110v supply, Figure 5-26
Q408		Same as Q401	Emitter follower for +110v supply, Figure 5-26
Q409		Same as Q403	Series Regulator +110v supply, Figure 5-10
Q410		Same as Q401	Differential Amplifier -100v supply, Figure 5-26
Q411		Same as Q401	Differential Amplifier -100v supply, Figure 5-26
Q412		Same as Q401	Emitter Follower -100v supply, Figure 5-26
Q413		Same as Q403	Series Regulator -100v supply, Figure 5-10
Q414		Same as Q401	Comparison Amplifier for 6.3v supply, Figure 5-26
Q415		Same as Q401	Comparison Amplifier Emitter Follower, Figure 5-26
Q416		Same as Q403	Emitter Follower 6.3v supply, Figure 5-10
Q417		TRANSISTOR, 2N174 per MIL-T-19500/13A	Series Regulator 6.3v supply, Figure 5-10
Q418		Same as Q403	Series Regulator +110v supply, Figure 5-10
Q419		Same as Q403	Series Regulator -100v supply, Figure 5-10

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
Q420- Q499		Not Assigned	
R1		RESISTOR, FIXED, COMPOSITION, 1 megohm, 10%, 1/2 Watt, type RC20GF105K per MIL-R-11C	Grid Return Resistor For V1, Figure 5-11
R2		RESISTOR, FIXED, COMPOSITION, 56 ohms, 10%, 1/4 Watt, type RC07GF560K per MIL-R-11C	Parasitic Suppressor for V1A, Figure 5-11
R3		Same as R1	Grid Return for V1B, Figure 5-11
R4		Same as R2	Parasitic Suppressor for V1B, Figure 5-11
R5		RESISTOR, FIXED, FILM, 5600 ohms, 5%, 3 Watt, (14674 #LPI-3-5. 6K-5%)	Cathode Resistor V1A, Figure 5-11
R6		Same as R5	Cathode Resistor V1B, Figure 5-11
R7		RESISTOR, FIXED, FILM, 1400 ohms, 1%, 1 Watt, (19701 type DC1)	Plate Resistor V2A, Figure 5-11
R8		RESISTOR, FIXED, COMPOSITION, 2700 ohms, 5%, 1/4 Watt, type RC07GF272J per MIL-R-11C	Coupling Resistor V3A, Figure 5-11
R9		Same as R5	Cathode Resistor V2A, Figure 5-11
R10		RESISTOR, VARIABLE, composition, 100 ohms, 20%, 2 Watt, type RV4LAYSA101B per MIL-R-94B	Gain Adjust Resistor V2, Figure 6-2
R11		Same as R5	Cathode Resistor V2B, Figure 5-11
R12		Same as R7	Plate Resistor V2B, Figure 5-11
R13		Same as R8	Coupling Resistor V3B, Figure 5-11
R14		Same as R1	Grid Resistor V4A, Figure 5-11
R15		RESISTOR, FIXED, COMPOSITION, 1200 ohms, 10%, 1/2 Watt, type RC20GF122K per MIL-R-11C	Plate Resistor V4A, Figure 5-11
R16		RESISTOR, FIXED, COMPOSITION, 220 ohms, 10%, 1/2 Watt, type RC20GF221K per MIL-R-11C	Cathode Resistor V4A, Figure 5-11
R17		Same as R1	Grid Return Resistor V4B, Figure 5-11
R18		RESISTOR, FIXED, COMPOSITION, 11K ohms, 5%, 2 Watt, type RC42GF113J per MIL-R-11C	Cathode Resistor V4B, Figure 5-11
R19- R21		Not Assigned	
R22		RESISTOR, FIXED, FILM, 1400 ohms, 1%, 1/4 Watt, type RN65B1401F per MIL-R-10509C	Coupling Resistor Delay Line DL1, Figure 5-11
R23		Same as R22	Coupling Resistor Delay Line DL2, Figure 5-11
R24		RESISTOR, FIXED, FILM, 1500 ohms, 1%, 1/4 Watt, type RN65B1501F per MIL-R-10509C	Delay Line Termination, Figure 5-12
R25		RESISTOR, FIXED, COMPOSITION, 1500 ohms, 5%, 2 Watt, type RC42GF152J per MIL-R-11C	Delay Line Termination, Figure 5-12
R26-		Not Assigned	
R27		Same as R24	Delay Line Termination, Figure 5-12
R28- R29		Not Assigned	
R30		RESISTOR, FIXED, COMPOSITION, 10 ohms, 10%, 1/2 Watt, type RC20GF100K per MIL-R-11C	Parasitic Suppressor Resistor for V6, Figure 5-12

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R31		Same as R30	Parasitic Suppressor Resistor for V6, Figure 5-12
R32		RESISTOR, FIXED, FILM, 1200 ohms, 5%, 3 Watt, (14674 #LPI-3-1.2K-5%)	Cathode Resistor for V6, Figure 5-12
R33		RESISTOR, VARIABLE, composition, 250 ohms, 10%, 2 Watt, type RV4LAYSA251A per MIL-R-94B	Vertical Ampl. High Freq. Adjustment, Figure 6-2
R34		Same as R32	Cathode Resistor V7, Figure 5-12
R35		Same as R30	Parasitic Suppressor Resistor for V5, Figure 5-12
R36		Same as R30	Parasitic Suppressor Resistor for V5, Figure 5-12
R37-R39		Not Assigned	
R40		RESISTOR, FIXED, COMPOSITION, 2200 ohms, 10%, 1/2 Watt, type RC20GF222K per MIL-R-11C	Coupling Resistor for V8, V10, Figure 5-12
R41		RESISTOR, FIXED, METAL OXID. FILM, 6000 ohms, 5%, 5 Watt at 40°C., (14674 #LPI-5-6K-5%)	Plate Resistor for V8, V9, Figure 5-13
R42		Same as R41	Plate Resistor for V8, V9, Figure 5-13
R43		Same as R41	Plate Resistor for V8, V9, Figure 5-13
R44		Same as R41	Plate Resistor for V8, V9, Figure 5-13
R45		RESISTOR, FIXED, COMPOSITION, 1000 ohms, 5%, 1/2 Watt, type RC20GF102J per MIL-R-11C	Coupling Resistor for V8, V9, Figure 5-13
R46		RESISTOR, FIXED, METAL FILM, 400 ohms, 5%, 7 Watt at 25°C., (14674 #LPI-7-400-5%)	Cathode Resistor for V8, V9, V10, V11, Figure 5-6
R47		Same as R25	Cathode Resistor for V8, V9, V10, V11, Figure 5-12
R48		Same as R41	Plate Resistor for V10, V11, Figure 5-13
R49		Same as R41	Plate Resistor for V10, V11, Figure 5-13
R50		Same as R41	Plate Resistor for V10, V11, Figure 5-13
R51		Same as R41	Plate Resistor for V10, V11, Figure 5-13
R52		Same as R45	Coupling Resistor for V10, V11, Figure 5-13
R53-R54		Not Assigned	
R55		RESISTOR, FIXED, FILM, 560 ohms, 5%, 3 Watt, (14674 #LPI-3-560-5%)	Decoupling Resistor for +88v, Figure 5-11
R56		RESISTOR, FIXED, COMPOSITION, 47 ohms, 10%, 1/2 Watt, type RC20GF470K per MIL-R-11C	Decoupling Resistor for +109v, Figure 5-11
R57		RESISTOR, FIXED, COMPOSITION, 100 ohms, 10%, 1/2 Watt, type RC20GF101K per MIL-R-11C	Decoupling Resistor for -99v, Figure 5-11
R58		RESISTOR, FIXED, WIRE WOUND, 10,000 ohms, 5%, 12 Watt, type RW32G103 per MIL-R-26C	Decoupling Resistor for +180v, Figure 5-6

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R59		RESISTOR, FIXED, WIRE WOUND, 2.2 K ohms, 5%, 12 Watt, type RW33G222 per MIL-R-26C	Decoupling Resistor for +370v, Figure 5-10
R60		Same as R59	Decoupling Resistor for +370v, Figure 5-10
R61		RESISTOR, FIXED, COMPOSITION, 4700 ohms, 10%, 1 Watt, type RC32GF472K per MIL-R-11C	Cathode Resistor for V5A, Figure 5-14
R62		Same as R61	Cathode Resistor for V5B, Figure 5-14
R63		RESISTOR, FIXED, COMPOSITION, 820 ohms, 5%, 1/2 Watt, type RC20GF821J per MIL-R-11C	Cathode Resistor for V5A, Figure 5-14
R64		RESISTOR, FIXED, FILM, 14.4K ohms, 1%, 1 Watt, (19701 type DC1)	Cathode Resistor for V5A, Figure 5-14
F65		Same as R64	Cathode Resistor for V5B, Figure 5-14
R66		Same as R63	Cathode Resistor for V5B, Figure 5-14
R67		RESISTOR, FIXED, FILM, 7.96K ohms, 1%, 1/4 Watt, RN65 size per MIL-R-10509C, (19701 type CF1/4)	Cathode Resistor for V5A, Figure 5-14
R68		Same as R67	Cathode Resistor for V5B, Figure 5-14
R69		RESISTOR, FIXED, COMPOSITION, 1000 ohms, 5%, 1/4 Watt, type RC07GF102J per MIL-R-11C	Grid Resistor for V5A, Figure 5-12
R70		Same as R69	Grid Resistor for V5B, Figure 5-12
R71-R100		Not Assigned	
R101		RESISTOR, FIXED, COMPOSITION, 43,000 ohms, 5%, 1/2 Watt, type RC20GF433J per MIL-R-11C	Grid Return Resistor for V101, Figure 5-17
R102		RESISTOR, FIXED, COMPOSITION, 10,000 ohms, 5%, 1/2 Watt, type RC20GF103J per MIL-R-11C	Grid Return Resistor for V101, Figure 5-17
R103		Same as R1	Grid Return Resistor for V101, Figure 5-15
R104		RESISTOR, FIXED, COMPOSITION, 470K ohms, 10%, 1/2 Watt, type RC20GF474K per MIL-R-11C	Coupling Resistor for V101, Figure 5-15
R105		Part of S102, not separately replaceable	Trigger Level control, Figure 5-15
R106		RESISTOR, FIXED, COMPOSITION, 51,000 ohms, 5%, 1/2 Watt, type RC20GF513J per MIL-R-11C	Grid Return Resistor for V101, Figure 5-15
R107		Same as R16	Parasitic Suppressor for V101B, Figure 5-16
R108		RESISTOR, FIXED, COMPOSITION, 56 ohms, 10%, 1/2 Watt, type RC20GF560K per MIL-R-11C	Parasitic Suppressor for V101A, Figure 5-16
R109		RESISTOR, FIXED, FILM, 30K ohms, 10%, 5 Watt, (14674 #LPI-5-30K-10%)	Plate Load Resistor for V101A, Figure 5-16
R110		RESISTOR, FIXED, COMPOSITION, 3300 ohms, 5%, 1 Watt, type RC32GF332J per MIL-R-11C	Plate Load Resistor for V101A, Figure 5-16
R111		RESISTOR, FIXED, COMPOSITION, 130 ohms, 5%, 1/2 Watt, type RC20GF131J per MIL-R-11C	Cathode Resistor for V101A, Figure 5-16
R112		Same as R111	Cathode Resistor for V101B, Figure 5-16

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R113		RESISTOR, FIXED, FILM, 6500 ohms, 5%, 3 Watt, (14674 #LPI-3-6.5K-5%)	Cathode Bias Resistor for V101, Figure 5-16
R114		RESISTOR, VARIABLE, COMPOSITION, 250K ohms, 10%, 2 Watt, type RV4LAYSA254A per MIL-R-94B	Trigger Symmetry Adj. for V103A, Figure 6-3
R115		RESISTOR, FIXED, COMPOSITION, 1 megohm, 5%, 1/2 Watt, type RC20GF105J per MIL-R-11C	Grid Return Resistor for V103A, Figure 5-16
R116		Same as R104	Coupling Resistor for V103A, Figure 5-16
R117		Same as R108	Parasitic Suppressor for V103A, Figure 5-16
R118		RESISTOR, FIXED, FILM, 698 ohms, 1%, 1/2 Watt, type RN70B6980F per MIL-R-10509C	Plate Load Resistor for V103A, Figure 5-16
R119		RESISTOR, FIXED, FILM, 249K ohms, 1%, 1/2 Watt, type RN70B2493F per MIL-R-10509C	Coupling Resistor for V103A, Figure 5-16
R120		RESISTOR, FIXED, FILM, 11K ohms, 5%, 4 Watt, (14674 #LPI-4-11K-5%)	Cathode Resistor for V103, Figure 5-16
R121		RESISTOR, FIXED, FILM, 499K ohms, 1%, 1/2 Watt, type RN70B4993F per MIL-R-10509C	Grid Return Resistor for V103B, Figure 5-16
R122		Same as R108	Parasitic Suppressor for V103B, Figure 5-16
R123		RESISTOR, FIXED, COMPOSITION, 1300 ohms, 5%, 1/2 Watt, type RC20GF132J per MIL-R-11C	Plate Load Resistor for V103B, Figure 5-16
R124		Same as R108	Parasitic Suppressor for V104A, Figure 5-16
R125		RESISTOR, FIXED, COMPOSITION, 1600 ohms, 5%, 1/2 Watt, type RC20GF162J per MIL-R-11C	Grid Return Resistor for V104A, Figure 5-16
R126-R129		Not Assigned	
R130		RESISTOR, FIXED, FILM, 12K ohms, 5%, 5 Watt, (14674 #LPI-5-12K-5%)	Plate Load Resistor for V104A, Figure 5-16
R131		RESISTOR, FIXED, FILM, 15K ohms, 5%, 5 Watt, (14674 #LPI-5-15K-5%)	Plate Load Resistor for V104A, Figure 5-16
R132		Same as R40	Parasitic Suppressor for V107A, Figure 5-16
R133		Same as R115	Coupling Resistor for V107A, Figure 5-16
R134		Same as R104	Grid Return Resistor for V107A, Figure 5-16
R135		RESISTOR, FIXED, COMPOSITION, 12K ohms, 10%, 2 Watt, type RC42GF123K per MIL-R-11C	Cathode Resistor for V107A, Figure 5-16
R136		Same as R108	Parasitic Suppressor for V107B, Figure 5-16
R137		Same as R104	Coupling Resistor for V107B, Figure 5-16
R138		Same as R135	Cathode Resistor for V107B, Figure 5-16

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R139		Same as R119	Coupling Resistor for V104B, Figure 5-16
R140		Same as R108	Parasitic Suppressor for V104B, Figure 5-16
R141		RESISTOR, FIXED, FILM, 182K ohms, 1%, 1/2 Watt, type RN70B1823F per MIL-R-10509C	Grid Return Resistor for V104A, Figure 5-16
R142		RESISTOR, FIXED, FILM, 5000 ohms, 5%, 3 Watt, (14674 #LPI-3-5K-5%)	Cathode Resistor for V104A, Figure 5-16
R143		Same as R108	Decoupling Resistor for V104A, Figure 5-16
R144		RESISTOR, FIXED, COMPOSITION, 15,000 ohms, 10%, 1 Watt, type RC32GF153K per MIL-R-11C	Cathode Resistor for V104B, Figure 5-16
R145		Same as R40	Parasitic Suppressor for V105A, Figure 5-16
R146		RESISTOR, FIXED, FILM, 1.65K ohms, 1%, 1/2 Watt, type RN70B1651F per MIL-R-10509C	Plate Load Resistor for V105A, Figure 5-16
R147		RESISTOR, FIXED, COMPOSITION, 82,000 ohms, 10%, 1/2 Watt, type RC20GF823K per MIL-R-11C	Plate Load Resistor for V105A, Figure 5-16
R148		Same as R121	Voltage Divider Resistor for V105B, Figure 5-16
R149		Same as R121	Voltage Divider Resistor for V105B, Figure 5-16
R150		Same as R108	Parasitic Suppressor for V105B, Figure 5-16
R151		Same as R108	Parasitic Suppressor for V109, Figure 5-16
R152		Same as R109	Plate Load Resistor for V109, Figure 5-16
R153		RESISTOR, FIXED, COMPOSITION, 560 ohms, 10%, 1/2 Watt, type RC20GF561K per MIL-R-11C	Screen Grid Resistor for V109, Figure 5-16
R154		Same as R108	Parasitic Suppressor for V115, Figure 5-16
R155		Same as R108	Parasitic Suppressor for V115, Figure 5-16
R156		RESISTOR, FIXED, COMPOSITION, 1.3 megohms, 5%, 1/2 Watt, type RC20GF135J per MIL-R-11C	Coupling Resistor for V115, Figure 5-16
R157		Same as R104	Grid Return Resistor for V115, Figure 5-16
R158		Same as R30	Coupling Resistor for V109, Figure 5-16
R159-R160		Not Assigned	
R161		RESISTOR, FIXED, COMPOSITION, 20,000 ohms, 5%, 1/2 Watt, type RC20GF203J per MIL-R-11C	Voltage Divider Resistor for Sweep Mode, Figure 5-17
R162		RESISTOR, VARIABLE, composition, 50K ohms, 10%, 1 Watt, Chicago (71450 type VF-90) (includes S103)	Sweep Mode control, Figure 5-17
R163		RESISTOR, VARIABLE, composition, 50K ohms, 10%, 2 Watt, type RV4LAYSA503A per MIL-R-94B	Sweep Mode Preset Adjust, Figure 6-3
R164		RESISTOR, FIXED, COMPOSITION, 47,000 ohms, 5%, 1/2 Watt, type RC20GF473J per MIL-R-11C	Voltage Divider Resistor for Sweep Mode, Figure 5-17
R165		RESISTOR, FIXED, COMPOSITION, 22 megohms, 10%, 1/2 Watt, type RC20GF226K per MIL-R-11C	Grid Return for V113B, Figure 5-16
R166-		Not Assigned	
R167		Same as R108	Parasitic Suppressor for V113A, Figure 5-16

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R168		RESISTOR, FIXED, COMPOSITION, 180K ohms, 10%, 1/2 Watt, type RC20GF184K per MIL-R-11C	Dropping Resistor for Sweep Armed, Figure 5-16
R169		RESISTOR, FIXED, FILM, 25.2K ohms, 1%, 1 Watt, (19701 type DC1)	Plate Load Resistor for V113A, Figure 5-16
R170		RESISTOR, FIXED, FILM, 100K ohms, 1%, 1/2 Watt, type RN70B1003F per MIL-R-10509C	Voltage Divider Resistor for V113B, Figure 5-16
R171		RESISTOR, FIXED, FILM, 17.4K ohms, 1%, 1 Watt, (19701 type DC1)	Cathode Resistor for V113, Figure 5-16
R172		RESISTOR, FIXED, COMPOSITION, 1000 ohms, 10%, 1/2 Watt, type RC20GF102K per MIL-R-11C	Cathode Resistor for V113B, Figure 5-16
R173		Same as R108	Parasitic Suppressor for V113B, Figure 5-16
R174		RESISTOR, FIXED, FILM, 71.5K ohms, 1%, 1/4 Watt, type RN65B7152F per MIL-R-10509C	Voltage Divider Resistor for V113B, Figure 5-16
R175		Same as R108	Parasitic Suppressor for V114A, Figure 5-16
R176		Same as R161	Voltage Divider Resistor for Sweep Length, Figure 5-16
R177		RESISTOR, FIXED, COMPOSITION, 15,000 ohms, 5%, 1/2 Watt, type RC20GF153J per MIL-R-11C	Voltage Divider Resistor for Sweep Length, Figure 5-16
R178		RESISTOR, VARIABLE, composition, 25,000 ohms, 20%, 2 Watt, type RV4LAYSA253B per MIL-R-94B	Sweep Length Adj, Figure 6-3
R179		RESISTOR, FIXED, COMPOSITION, 15K ohms, 10%, 2 Watt, type RC42GF153K per MIL-R-11C	Cathode Resistor for V115 Figure 5-16
R180		RESISTOR, FIXED, COMPOSITION, 56,000 ohms, 10%, 1/2 Watt, type RC20GF563K per MIL-R-11C	Coupling Resistor for V114B, Figure 5-16
R181		Same as R108	Parasitic Suppressor for V114B, Figure 5-16
R182		RESISTOR, FIXED, COMPOSITION, 18K ohms, 10%, 2 Watt, type RC42GF183K per MIL-R-11C	Cathode Resistor for V114B, Figure 5-16
R183		Same as R115	Cathode Resistor for V114A, Figure 5-16
R184- R185		Not Assigned	
R186		Same as R108	Decoupling Resistor +110v supply in Sweep Generator, Figure 5-16
R187		Same as R108	Decoupling Resistor +110v supply in Sweep Generator, Figure 5-16
R188		Same as R57	Decoupling Resistor +110v supply in Sweep Generator, Figure 5-16
R189		Same as R108	Decoupling Resistor +370v supply in Sweep Generator, Figure 5-16
R190		Same as R57	Decoupling Resistor -100v supply in Sweep Generator, Figure 5-16
R191- R200		Not Assigned	
R201		Same as R119	Coupling for V201A, Figure 5-19

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R202		RESISTOR, VARIABLE, composition, 1 megohm, 10%, 2 Watt, type RV4LAYSA105A per Mil-R-94B	Sweep Gain Adj, Figure 5-19
R203		RESISTOR, FIXED, FILM, 900K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2)	Attenuator Resistor for V201 input, Figure 5-19
R204		RESISTOR, FIXED, FILM, 111K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Attenuator Resistor for V201 input, Figure 5-19
R205		RESISTOR, FIXED, FILM, 1 megohm, 1%, 1/2 Watt, type RN70B1004F per MIL-R-10509C	Grid Return Resistor for V201B, Figure 5-21
R206		RESISTOR, FIXED, COMPOSITION, 100K ohms, 10%, 1/2 Watt, type RC20GF104K per MIL-R-11C	Coupling Resistor for V201B, Figure 5-21
R207		Same as R57	Parasitic Suppressor for V201B, Figure 5-21
R208		Same as R135	Cathode Resistor for V201B, Figure 5-21
R209		RESISTOR, VARIABLE, 2000 ohms, 20%, 1 Watt, supplied with spst switch S203 (71450 type RGC-90)	External Vernier (horizontal gain A200), Figure 5-18
R210		RESISTOR, FIXED, COMPOSITION, 560 ohms, 10%, 1 Watt, type RC32GF561K per MIL-R-11C	Cathode Bias Resistor for V201B, Figure 5-18
R211		RESISTOR, VARIABLE, composition, 1000 ohms, 20%, 2 Watt, type RV4LAYSA102B per MIL-R-94B	Vernier Balance, Figure 6-3
R212		Same as R202	Gain Adj, Figure 5-19
R213		Same as R119	Coupling Resistor for V201A, Figure 5-19
R214		Same as R108	Parasitic Suppressor for V201A, Figure 5-21
R215		Same as R205	Grid Return Resistor for V201A, Figure 5-21
R216		RESISTOR, VARIABLE, linear - precision, 50K ohms, 5%, resistance tol., 0.5 linearity tol., 3 Watt, (73138 type SC731)	Horizontal Position Control, Figure 3-1
R217		RESISTOR, FIXED, COMPOSITION, 27K ohms, 10%, 2 Watt, type RC42GF273K per MIL-R-11C	Cathode Resistor for V201A, Figure 5-21
R218		Same as R108	Parasitic Suppressor for V202A, Figure 5-21
R219-R220		Not Assigned	
R221		RESISTOR, FIXED, FILM, 8.2K ohms, 5%, 3 Watt, (14674 #LPI-3-8.2K-5%)	Cathode Resistor for V202A, Figure 5-21
R222		Same as R221	Cathode Resistor for V202B, Figure 5-21
R223AB		RESISTOR, VARIABLE, dual tandem, 100 ohms, 20%, 1 Watt each section, (01121 type JJ #JD1L040S101MC)	X100 Gain Adj. for horizontal amplifier, Figure 6-3
R224		Same as R102	Parasitic Suppressor for V202B, Figure 5-21
R225-R232		Not Assigned	
R233		RESISTOR, FIXED, FILM, 11.8K ohms, 1%, 1/2 Watt, type RN70B1182F per MIL-R-10509C	Attenuator Resistor for Q201, Figure 5-18
R234		RESISTOR, FIXED, FILM, 3600 ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2)	Attenuator Resistor for Q201, Figure 5-18
R235		RESISTOR, FIXED, FILM, 2120 ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Attenuator Resistor for Q201, Figure 5-18
R236		RESISTOR, FIXED, FILM, 920 ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Attenuator Resistor for Q201, Figure 5-18
R237		RESISTOR, FIXED, FILM, 365 ohms, 1%, 1/2 Watt, type RN70B3650F per MIL-R-10509C	Attenuator Resistor for Q201, Figure 5-18

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R238		RESISTOR, FIXED, FILM, 121 ohms, 1%, 1/2 Watt, type RN70B1210F per MIL-R-10509C	Attenuator Resistor for Q201, Figure 5-18
R239		Same as R238	Emitter Resistor for Q201, Figure 5-18
R240		Same as R238	Emitter Resistor for Q202, Figure 5-18
R241		Same as R238	Attenuator Resistor for Q202, Figure 5-18
R242		Same as R237	Attenuator Resistor for Q202, Figure 5-18
R243		Same as R114	Horizontal Bal. Adj, Figure 5-20
R244		Same as R206	DC Balance for horizontal ampl. Q201, Figure 5-20
R245		RESISTOR, FIXED, FILM, 30.5K ohms, 1%, 1 Watt, (19701 type DC1)	Feedback Resistor for V204, Figure 5-20
R246		RESISTOR, high frequency compensator. (28569 #18690-15)	Feedback Resistor for V204, Figure 5-20
R247		Same as R204	Bias Resistor for Q201, Q202, Figure 5-20
R248		RESISTOR, FIXED, FILM, 25.5K ohms, 1%, 1 Watt, (19701 type DC1)	Voltage Divider Resistor Bias for Q201, Q202, Figure 5-20
R249		Same as R108	Parasitic Suppressor for V203A, Figure 5-20
R250		RESISTOR, FIXED, FILM, 9090 ohms, 1%, 1 Watt, (19701 type DC1)	Collector Load Resistor for Q201, Figure 5-20
R251		Same as R248	Dropping Resistor for Q201, Q202 supply, Figure 5-20
R252		Same as R250	Collector Load Resistor for Q202, Figure 5-20
R253		Same as R108	Parasitic Suppressor for V203B, Figure 5-20
R254		RESISTOR, FIXED, COMPOSITION, 10K ohms, 10%, 2 Watt, type RC42GF103K per MIL-R-11C	Cathode Resistor for V203B, Figure 5-20
R255		Same as R254	Cathode Resistor for V203A, Figure 5-20
R256		Same as R108	Parasitic Suppressor for V204, Figure 5-20
R257		Same as R108	Parasitic Suppressor for V205, Figure 5-20
R258		RESISTOR, FIXED, COMPOSITION, 220K ohms, 10%, 1/2 Watt, type RC20GF224K per MIL-R-11C	Voltage Divider Resistor for Q202 supply, Figure 5-20
R259		Same as R245	Feedback Resistor for V205, Figure 5-20
R260		Same as R246	Feedback Resistor for V205, Figure 5-20
R261-R263		Not Assigned	
R264		Same as R206	Grid Return Resistor for V206A, Figure 5-20

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R265		RESISTOR, FIXED, WIRE WOUND, 12,000 ohms, 5%, 18 Watt, type RW33G123 per MIL-R-26C	Plate Load Resistor for V204, Figure 5-10
R266		Same as R108	Parasitic Suppressor for V206A, Figure 5-20
R267		RESISTOR, FIXED, FILM, 2000 ohms, 5%, 7 Watt, (14674 #LPI-7-2K-5%)	Cathode Resistor for V204, V205, Figure 5-20
R268		RESISTOR, FIXED, COMPOSITION, 3900 ohms, 10%, 2 Watt, type RC42GF392K per MIL-R-11C	Cathode Resistor for V204, V205 Beam Finder, Figure 5-20
R269		Same as R108	Parasitic Suppressor for V206B, Figure 5-20
R270		Same as R265	Plate Load Resistor for V205, Figure 5-10
R271		RESISTOR, FIXED, COMPOSITION, 390 ohms, 10%, 1/2 Watt, type RC20GF391K per MIL-R-11C	Cathode Resistor for V207, Figure 5-20
R272		RESISTOR, FIXED, COMPOSITION, 2700 ohms, 10%, 1/2 Watt, type RC20GF272K per MIL-R-11C	Grid Return Resistor for V207, Figure 5-20
R273		RESISTOR, FIXED, COMPOSITION, 4700 ohms, 10%, 1/2 Watt, type RC20GF472K per MIL-R-11C	Grid Return Resistor for V206B, Figure 5-20
R274		RESISTOR, FIXED, COMPOSITION, 4700 ohms, 10%, 2 Watt, type RC42GF472K per MIL-R-11C	Cathode Resistor for V206B, Figure 5-20
R275		Same as R274	Cathode Resistor for V206B, Figure 5-20
R276		RESISTOR, FIXED, COMPOSITION, 5600 ohms, 10%, 2 Watt, type RC42GF562K per MIL-R-11C	Cathode Resistor for V206B, Figure 5-20
R277		Same as R56	Decoupling Resistor for +110v supply in Horizontal Amplifier, Figure 5-21
R278		RESISTOR, FIXED, COMPOSITION, 3300 ohms, 10%, 2 Watt, type RC42GF332K per MIL-R-11C	Decoupling Resistor for +370v supply in Horizontal Amplifier, Figure 5-20
R279-R300		Not Assigned	
R301		RESISTOR, FIXED, FILM, 38K ohms, 10%, 4 Watt, (14674 #LPI-4-38K-10%)	Plate Load Resistor for V301B, Figure 5-23
R302		RESISTOR, FIXED, COMPOSITION, 91,000 ohms, 5%, 1/2 Watt, type RC20GF913J per MIL-R-11C	Coupling Resistor for V301B, Figure 5-23
R303		Same as R168	Bias Resistor for V301B, Figure 5-23
R304		RESISTOR, FIXED, COMPOSITION, 120K ohms, 10%, 2 Watt, type RC42GF124K per MIL-R-11C	Plate Load Resistor for V301A, Figure 5-23
R305		Same as R56	Parasitic Suppressor for V301A, Figure 5-23
R306		RESISTOR, VARIABLE, composition, 1.5 megohms, 20%, 2 Watt, type RV4LAYSA155B per MIL-R-94B	High Voltage Adj, Figure 6-2
R307		RESISTOR, FIXED, FILM, 3.6 megohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Dropping Resistor for focus circuit, Figure 5-23
R308		RESISTOR, FIXED, FILM, 50 megohms, 10%, 4 Watt, (77764 type HFQW)	Dropping Resistor for focus circuit, Figure 5-24
R309		RESISTOR, VARIABLE, 5 megohms, 30%, 1/2 Watt, (12697 type 37 with high voltage shaft and bushing)	Focus control, Figure 3-1
R310		Same as R307	Dropping Resistor focus circuit, Figure 5-24

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R311		RESISTOR, FIXED, COMPOSITION, 56,000 ohms, 10%, 1 Watt, type RC32GF563K per MIL-R-11C	Voltage Divider Resistor Astigmatism Adj, Figure 5-11
R312		RESISTOR, VARIABLE, composition, 100K ohms, 20%, 2 Watt, type RV4LAYSA104B per MIL-R-94B	Astigmatism Control, Figure 6-2
R313		Same as R1	Coupling Resistor for V305 heater, Figure 5-24
R314-R317		Not Assigned	
R318		Same as R172	Plate Load Resistor for V302, Figure 5-23
R319		Same as R57	Parasitic Suppressor for V302, Figure 5-23
R320		Same as R206	Grid Return Resistor for V302, Figure 5-23
R321		RESISTOR, FIXED, COMPOSITION, 10,000 ohms, 10%, 1/2 Watt, type RC20GF103K per MIL-R-11C	Filter Resistor for V303, Figure 6-6
R322		RESISTOR, FIXED, COMPOSITION, 27,000 ohms, 10%, 1/2 Watt, type RC20GF273K per MIL-R-11C	Cathode Resistor for V305, Figure 5-24
R323		RESISTOR, FIXED, COMPOSITION, 2.2 megohms, 10%, 1/2 Watt, type RC20GF225K per MIL-R-11C	Load Resistor Internal Modulation, Figure 5-24
R324		RESISTOR, FIXED, COMPOSITION, 47,000 ohms, 10%, 1/2 Watt, type RC20GF473K per MIL-R-11C	Cathode Resistor for V305 beam finder, Figure 5-23
R325		Same as R202	Intensity Adj, Figure 5-24
R326		RESISTOR, VARIABLE, composition, 1.2 megohms, 30%, 1/2 Watt, (12697 type 37 with high voltage shaft and bushing)	Intensity Control, Figure 3-1
R327		RESISTOR, FIXED, FILM, 50 megohms, 10%, 2 Watt, (77764 type BBMW)	Dropping Resistor for V109, Figure 5-24
R328		RESISTOR, FIXED, COMPOSITION, 1.5 megohms, 10%, 1/2 Watt, type RC20GF155K per MIL-R-11C	Coupling Resistor for V305, Figure 5-24
R329		RESISTOR, FIXED, COMPOSITION, 33,000 ohms, 10%, 1/2 Watt, type RC20GF333K per MIL-R-11C	Coupling Resistor for unblanking, Figure 5-24
R330		Same as R322	Coupling Resistor for unblanking gate, Figure 5-24
R331		Same as R206	Load Resistor for unblanking gate, Figure 5-24
R332-R334		Not Assigned	
R335		Same as R18	Plate Load Resistor for V306A, Figure 5-23
R336		Same as R268	Cathode Resistor for V306A, Figure 5-23
R337		Same as R56	Parasitic Suppressor for V306A, Figure 5-23
R338		RESISTOR, FIXED, COMPOSITION, 18 megohms, 5%, 1/2 Watt, type RC20GF186J per MIL-R-11C	Grid Return Resistor for V306A, Figure 5-23
R339		Same as R56	Parasitic Suppressor for V306B, Figure 5-23
R340		RESISTOR, FIXED, COMPOSITION, 16 megohms, 5%, 1/2 Watt, type RC20GF166J per MIL-R-11C	Grid Return Resistor for V306B, Figure 5-23
R341		RESISTOR, FIXED, COMPOSITION, 2 megohms, 5%, 1/2 Watt, type RC20GF205J per MIL-R-11C	Bias Resistor for V306B, Figure 5-22

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R342		RESISTOR, FIXED, FILM, 33K ohms, 5%, 5 Watt, (14674 #LPI-5-33K-5%)	Plate Load Resistor for V306B, Figure 5-23
R343		RESISTOR, FIXED, FILM, 2000 ohms, 1%, 1/2 Watt, type RN70B2001F per MIL-R-10509C	Attenuator Resistor for calibrator, Figure 5-22
R344		Same as R233	Attenuator Resistor for calibrator, Figure 5-22
R345		RESISTOR, FIXED, FILM, 6190 ohms, 1%, 1/2 Watt, type RN70B6191F per MIL-R-10509C	Attenuator Resistor for calibrator, Figure 5-22
R346		RESISTOR, FIXED, FILM, 2030 ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Attenuator Resistor for calibrator, Figure 5-22
R347		RESISTOR, FIXED, FILM, 1030 ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Attenuator Resistor for calibrator, Figure 5-22
R348		RESISTOR, FIXED, FILM, 600 ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Attenuator Resistor for calibrator, Figure 5-22
R349		RESISTOR, FIXED, FILM, 200 ohms, 1%, 1/2 Watt, type RN70B2000F per MIL-R-10509C	Attenuator Resistor for calibrator, Figure 5-22
R350		RESISTOR, FIXED, FILM, 100 ohms, 1%, 1/2 Watt, type RN70B1000F per MIL-R-10509C	Attenuator Resistor for calibrator, Figure 5-22
R351		RESISTOR, FIXED, FILM, 60.4 ohms, 1%, 1/2 Watt, type RN70B60R4F per MIL-R-10509C	Attenuator Resistor for calibrator, Figure 5-22
R352		RESISTOR, FIXED, FILM, 40.2 ohms, 1%, 1/2 Watt, type RN70B40R2F per MIL-R-10509C	Attenuator Resistor for calibrator, Figure 5-22
R353		RESISTOR, FIXED, FILM, 200K ohms, 1%, 1/2 Watt, type RN70B2003F per MIL-R-10509C	Attenuator Resistor for calibrator, Located on E301
R354		Same as R349	Attenuator Resistor for calibrator, Located on E301
R355-R399		Not Assigned	
R400		Same as R180	Dropping Resistor for DS401, Located on DS401
R401		RESISTOR, FIXED, COMPOSITION, 39,000 ohms, 10%, 1/2 Watt, type RC20GF393K per MIL-R-11C	Dropping Resistor for DS402, Figure 5-8
R402		RESISTOR, FIXED, COMPOSITION, 68K ohms, 10%, 2 Watt, type RC42GF683K per MIL-R-11C	Load Resistor for +370v supply, Figure 5-7
R403		RESISTOR, FIXED, WIRE WOUND, 50 ohms, 5%, 10 Watt, type RW31G500 per MIL-R-26C	Series Resistor for +370v supply, Figure 5-7
R404		Not Assigned	
R405		RESISTOR, FIXED, WIRE WOUND, 160 ohms, 5%, 10 Watt, type RW31G161 per MIL-R-26C	Bias Resistor for Q403, Figure 5-10
R406		Same as R405	Bias Resistor for Q404, Figure 5-10
R407		Same as R405	Bias Resistor for Q405, Figure 5-10
R408		Same as R109	Bias Resistor for Q401, Figure 5-26
R409		Same as R57	Coupling Resistor for Q401, Figure 5-26
R410		RESISTOR, FIXED, FILM, 20K ohms, 5%, 5 Watt, (14674 #LPI-5-20K-5%)	Voltage Divider Resistor for Q401, Figure 5-26
R411		RESISTOR, VARIABLE, composition, 10K ohms, 10%, 2 Watt, type RV4LAYSA103A per MIL-R-94B	+370v Adj, Figure 5-8
R412		Same as R410	Emitter Resistor for Q402, Q401, Figure 5-26

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R413		Same as R18	Collector Load Resistor for Q402, Figure 5-26
R414		Not Assigned	
R415		RESISTOR, FIXED, COMPOSITON, 130K ohms, 5%, 1 Watt, type RC32GF134J per MIL-R-11C	Bias Voltage Divider Resistor for Q402, Figure 5-26
R416		RESISTOR, FIXED, COMPOSITION, 510 ohms, 5%, 1/2 Watt, type RC20GF511J per MIL-R-11C	Bias Voltage Divider Resistor for Q402 Figure 5-26
R417		RESISTOR, FIXED, COMPOSITION, 33 ohms, 10%, 1/2 Watt, type RC20GF330K per MIL-R-11C	Coupling Resistor for Q405, Figure 5-26
R418-R420		Not Assigned	
R421		RESISTOR, FIXED, WIRE WOUND, 71 ohms, 5%, 17 Watt, type RW32V710 per MIL-R-26C	Bias Resistor for Q418, Figure 5-10
R422		Same as R135	Load Resistor for +110v supply, Figure 5-7
R423		RESISTOR, FIXED, COMPOSITION, 33 ohms, 10%, 2 Watt, type RC42GF330K per MIL-R-11C	Series Resistor for +110v supply, Figure 5-7
R424		RESISTOR, FIXED, WIRE WOUND, 50 ohms, 5%, 17 Watt, type RW32V500 per MIL-R-26C	Bias Resistor for Q418, Figure 5-10
R425		RESISTOR, FIXED, COMPOSITION, 110 ohms, 5%, 1/2 Watt, type RC20GF111J per MIL-R-11C	Coupling Resistor for Q408, Figure 5-26
R426		RESISTOR, FIXED, COMPOSITION, 27,000 ohms, 10%, 1 Watt, type RC32GF273K per MIL-R-11C	Bias Resistor for Q409, Figure 5-26
R427		RESISTOR, FIXED, WIRE WOUND, 18 ohms, 5%, 3 Watt, type RW59V180 per MIL-R-26C	Bias Resistor for Q418, Figure 5-26
R428		Same as R113	Bias Voltage Divider Resistor for Q406, Figure 5-26
R429-		Not Assigned	
R430		Same as R142	Bias Voltage Divider Resistor for Q406, Figure 5-26
R431		RESISTOR, VARIABLE, COMPOSITION, 1500 ohms, 10%, 2 Watt, type RV4LAYSA152A per MIL-R-94B	-100v Adj, Figure 5-8
R432		Same as R311	Emitter Resistor for Q406, Q407, Figure 5-26
R433		Same as R302	Collector Load Resistor for Q407, Figure 5-26
R434		RESISTOR, FIXED, COMPOSITION, 100K ohms, 5%, 1/2 Watt, type RC20GF104J per MIL-R-11C	Bias Voltage Divider Resistor for Q407, Figure 5-26
R435		Same as R416	Bias Voltage Divider Resistor for Q407, Figure 5-26
R436-R437		Not Assigned	
R438		Same as R405	Bias Resistor for Q419, Figure 5-10
R439		RESISTOR, FIXED, WIRE WOUND, 12 ohms, 5%, 6.5 Watt, type RW57V120 per MIL-R-26C	Series Resistor -100v supply, Figure 5-10
R440		Same as R135	Load Resistor for -100v supply, Figure 5-7
R441		Same as R423	Series Resistor for -100v supply, Figure 5-7

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R442		RESISTOR, FIXED, WIRE WOUND, 120 ohms, 5%, 10 Watt, type RW31G121 per MIL-R-26C	Bias Resistor for Q419, Figure 5-10
R443		RESISTOR, FIXED, COMPOSITION, 18 ohms, 10%, 1/2 Watt, type RC20GF180K per MIL-R-11C	Coupling Resistor for Q412, Figure 5-26
R444		RESISTOR, FIXED, COMPOSITION, 22,000 ohms, 10%, 1 Watt, type RC32GF223K per MIL-R-11C	Bias Resistor for Q413, Figure 5-26
R445		RESISTOR, FIXED, COMPOSITION, 24 ohms, 5%, 2 Watt, type RC42GF240J per MIL-R-11C	Bias Resistor for Q419, Figure 5-26
R446		RESISTOR, FIXED, COMPOSITION, 1800 ohms, 5%, 2 Watt, type RC42GF182J per MIL-R-11C	Dropping Resistor for CR413, Figure 5-26
R447		RESISTOR, FIXED, COMPOSITION, 6800 ohms, 10%, 1/2 Watt, type RC20GF682K per MIL-R-11C	Dropping Resistor for V401, Figure 5-26
R448		Same as R426	Emitter Resistor for Q410, Q411, Figure 5-26
R449		RESISTOR, FIXED, COMPOSITION, 4300 ohms, 5%, 1/2 Watt, type RC20GF432J per MIL-R-11C	Collector Load Resistor for Q411, Figure 5-26
R450		Same as R113	Bias Voltage Divider Resistor for Q411, Figure 5-26
R451		RESISTOR, FIXED, COMPOSITION, 620 ohms, 5%, 1/2 Watt, type RC20GF621J per MIL-R-11C	Bias Voltage Divider Resistor for Q411, Figure 5-26
R452		Same as R211	-100v Adj, Figure 5-8
R453-R456		Not Assigned	
R457		Same as R423	Heater Balancing Resistor, Figure 5-6
R458		RESISTOR, FIXED, COMPOSITION, 330 ohms, 10%, 2 Watt, type RC42GF331K per MIL-R-11C	Load Resistor for 6.3v supply, Figure 5-7
R459		Same as R273	Bias Resistor for Q416, Figure 5-26
R460		RESISTOR, FIXED, WIRE WOUND, 1.5 ohms, 5%, 63 Watt, RW24 size per MIL-R-26C, (02642 #RW24G1R5)	Bypass Resistor for Q417, Figure 5-9
R461		RESISTOR, FIXED, COMPOSITION, 47,000 ohms, 10%, 1 Watt, type RC32GF473K per MIL-R-11C	Collector Load Resistor for Q414, Figure 5-26
R462		RESISTOR, FIXED, COMPOSITION, 150 ohms, 10%, 1/2 Watt, type RC20GF151K per MIL-R-11C	Bias Voltage Divider Resistor for Q414, Figure 5-26
R463		Same as R56	Bias Voltage Divider Resistor for Q414, Figure 5-26
R464		Same as R33	6.3v Adj, Figure 5-8
R465-R499		Not Assigned	
R1000-		Not Assigned	
R1001		RESISTOR, FIXED, COMPOSITION, 3.3 megohms, 10%, 1/2 Watt, type RC20GF335K per MIL-R-11C	Holdoff Timing Resistor, Figure 5-27
R1002		Same as R178	.1 sec Timing Resistor, Figure 6-3
R1003		Same as R178	10 Msec. Timing Resistor, Figure 6-3
R1004		Same as R178	1 Msec Timing Resistor, Figure 6-3
R1005		RESISTOR, FIXED, COMPOSITION, 510K ohms, 5%, 1/2 Watt, type RC20GF514J per MIL-R-11C	Holdoff Timing Resistor, Figure 5-27
R1006		Same as R141	Holdoff Timing Resistor, Figure 5-27

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1007		RESISTOR, FIXED, FILM, 160K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Holdoff Timing Resistor, Figure 5-27
R1008		Not Assigned	
R1009		RESISTOR, VARIABLE, 50K ohms, 20%, 1 Watt, (71450 type RGC-90) (includes S1002)	Sweep Vernier Control, Figure 3-1
R1010		RESISTOR, FIXED, COMPOSITION, 18,000 ohms, 5%, 1 Watt, type RC32GF183J per MIL-R-11C	Sweep Timing Resistor, Figure 5-10
R1011		RESISTOR, FIXED, FILM, 36 megohms, 1%, 2 Watt, (19701 type DC2)	Sweep Timing Resistor, Figure 5-27
R1012		RESISTOR, FIXED, FILM, 9 megohms, 1%, 1 Watt, (19701 type DC1)	Sweep Timing Resistor, Figure 5-27
R1013		Same as R1012	Sweep Timing Resistor, Figure 5-27
R1014		Same as R307	Sweep Timing Resistor, Figure 5-27
R1015		Same as R203	Sweep Timing Resistor, Figure 5-27
R1016		Same as R203	Sweep Timing Resistor, Figure 5-27
R1017		RESISTOR, FIXED, FILM, 360K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Sweep Timing Resistor, Figure 5-27
R1018		RESISTOR, FIXED, FILM, 90K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Sweep Timing Resistor, Figure 5-27
R1019		Same as R1018	Sweep Timing Resistor, Figure 5-27
R1020		Same as R1018	Sweep Timing Resistor, Figure 5-27
R1021		Same as R16	Sweep Timing Resistor, Figure 5-27
R1022		Not Assigned	
R1023		RESISTOR, FIXED, COMPOSITION, 47 ohms, 10%, 2 Watt, type RC42GF470K per MIL-R-11C	Dropping Resistor for DS1001, Figure 5-18
R1024		Same as R178	.1 Msec Timing Resistor, Figure 6-3
R1025		RESISTOR, VARIABLE, 50 ohms, 10%, 2 Watt, type RA20NBSD500A per MIL-R-19A (includes S403)	SCALE LIGHT control, Figure 3-1
S1		SWITCH, push button, 3 pole, double throw (76854 Type 175)	BEAM FINDER Switch, Figure 3-1
S2-S100		Not Assigned	
S101		SWITCH, ROTARY, 1 section, 4 position, (28569 #19912-433)	Trigger Source (A103) Figure 3-1
S102		SWITCH, ROTARY, 1 section, 2 position, (28569 #19912-432)	Trigger Slope (A100) Figure 3-1
S103		Part of R162	Part of Sweep Mode Control, Figure 5-17
S104-S200		Not Assigned	
S201		SWITCH, toggle, SPST, ST16A per JAN-S-23	AC-DC, Figure 3-1
S202		SWITCH, ROTARY, 5 section, 16 position, (28569 #19912-435)	Horizontal Display, Figure 3-1, 5-18
S203		Part of R209	Part of External Vernier, Figure 5-18
S204-S301		Not Assigned	
S302		SWITCH, ROTARY, 2 section, 11 position, (28569 #19912-437)	Calibrator (A300), Figure 5-22
S303-S400		Not Assigned	

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
S401		SWITCH, toggle, bat handle, DPST, 25 A at 125 VAC, 9 A at 250 VAC, ST52K per JAN-S-23	Power Switch, Figure 3-1
S402		SWITCH, THERMOSTATIC, SPDT, open 140^{0}F $\pm 5^{0}$, 1.1875 in. clearance hole w/2 no. 6 holes on 0.785 in. radius, 8 Amp rating, 250 V., (82647 #20400D-52-21-L140-2)	Thermal Overload Relay, Figure 5-8
S403		Part of R1025	SCALE LIGHT Control, Figure 3-1
S404-S499		Not Assigned	
S1000		Not Assigned	
S1001		SWITCH, ROTARY, 4 section, 24 position, 9 pole (28569 #19912-434)	Sweep Time/CM Switch, Figure 3-2
S1002		Part of R1009	Part of Sweep Vernier, Figure 3-1
T301		TRANSFORMER, HIGH VOLTAGE (28569 #20800-261) (existing stk of 98734 #6-1596 or 28480 #160A-11B may be used)	High Voltage Power Supply, Figure 6-6
T401		TRANSFORMER, power (28569 #20800-259) (existing stk of 28480 #9110-0128-9 may be used)	Low Voltage Power Supply, Figure 5-7
T402-T499		Not Assigned	
V1		TUBE, JAN 6922 per MIL-E-1/1168 NAVY	Cathode Follower
V2		Same as V1	Input Amplifier
V3		Same as VI	Cathode Follower
V4		Same as V1	Internal Trigger Ampl. and Cathode follower
V5		Same as V1	Cathode Follower
V6		Same as V1	Cathode Follower Driver
V7		Same as V1	Cathode Follower Driver
V8		Same as V1	Vertical Output Ampl.
V9		Same as V1	Vertical Output Ampl.
V10		Same as V1	Vertical Output Ampl.
V11		Same as V1	Vertical Output Ampl.
V12-V100		Not Assigned	
V101		Same as V1	Trigger Ampl.
V102		Same as DS402	Voltage Dropping Element for V101, Figure 5-16
V103		Same as V1	Trigger Generator
V104		Same as V1	Gate Generator
V105		Same as V1	Gate Generator and Clamp
V106		Same as V102	Voltage Dropping Element for V107A, Figure 5-16
V107		Same as V1	Cathode Follower
V108		Not Assigned	
V109		TUBE, JAN 6CL6 per MIL-E-1/864B	Integrator
V110		Same as DS402	Protecting Device for V103A, Figure 5-16
V111		Same as DS402	Protecting Device for V107A, Figure 5-16
V112		Not Assigned	

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
V113		Same as V1	Bias Control Cathode Follower
V114		Same as V1	Holdoff Cathode Follower and Sweep Output Cathode Follower
V115		Same as V1	Output Cathode Follower
V116		Same as DS402	Protecting Device for V115, Figure 5-16
V117-V200		Not Assigned	
V201		Same as V1	Input Cathode Follower
V202		Same as V1	Transistor Driver
V203		Same as V1	Driver Cathode Follower
V204		Same as V109	1/2 Differential Ampl.
V205		Same as V109	1/2 Differential Ampl.
V206		Same as V1	Output Cathode Follower
V207		Same as V109	Capacitance Driver
V208-V300		Not Assigned	
V301		Same as V1	Regulator HV supply, Figure 6-6
V302		TUBE, JAN 6005/6AQ5W per MIL-E-1D	Radio Frequency Oscillator, Figure 6-6
V303		TUBE, JAN 1X2B per MIL-E-1/1111	High Voltage Rectifier, Figure 6-6
V304		Same as V303	High Voltage Rectifier, Figure 6-6
V305		TUBE, cathode ray, 5 A, mono-accelerator flat face, 5000V accelerating potential, JAN 5AMP2 per MIL-E-1/1339	CRT, Figure 5-6
V306		Same as V1	Calibrator Multi-vibrator, Figure 6-6
V307		TUBE, JAN 5726/6AL5W per MIL-E-1D	Calibrator Clamp and Disconnect Diode, Figure 6-6
V308		Same as DS402	Protective Device for V301, Figure 5-23
V309		Same as DS402	Protective Device for V301, Figure 5-23
V310-V400		Not Assigned	
V401		TUBE, JAN 5651WA per MIL-E-1/825A	Regulator for -100v supply, located on circuit board A402
V402-V499		Not Assigned	
W401		CABLE ASSEMBLY, power, electrical (CX-4704/U(8'0"))	Power Cord
XDS401		SOCKET, lampholder, front mtg., 2 term, for T-2 neon glow lamp, (96312 #137-8536-93, red lens)	
XDS402		Not Assigned	
XDS403		SOCKET, lampholder Assy for four #47 lamps (#) or 96312 #157-8536-9) (Individual lamp holders may be purchased under 96312 #)	
XDS1001		SOCKET, lampholder only, miniature bayonet base type LH22 per MIL-L-3661A	

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XF401		HOLDER, FOR FUSE, extractor post type, 3AG size, type FD-1 per MIL-STD-242C	
XF402		Same as XF401	
XF403		Same as XF401	
XF404		Same as XF401	
XF405		Same as XF401	
XF406		Same as XF401	
XV1		SOCKET, ELECTRON TUBE, 9 pin, noval, stand-off type, mica filled phenolic body with 2 integrally molded tube retainer lugs (91662 #3906-2-4)	Figure 5-11
XV2		SOCKET, ELECTRON TUBE, 9 pin, noval, UHF stand-off type, mica filled phenolic body, (91662 #3901PHSPTD)	Figure 5-11
XV3		Same as XV2	
XV4		Same as XV1	Figure 5-11
XV5		Same as XV2	Figure 5-12
XV6		Same as XV1	Figure 5-12
XV7		Same as XV1	Figure 5-12
XV8		Same as XV2	Figure 5-13
XV9		Same as XV2	Figure 5-13
XV10		Same as XV2	Figure 5-13
XV11		Same as XV2	Figure 5-13
XV12-XV100		Not Assigned	
XV101		Same as XV1	Figure 5-16
XV102		Not Assigned	
XV103		Same as XV1	Figure 5-16
XV104		Same as XV1	Figure 5-16
XV105		Same as XV1	Figure 5-16
XV106		Not Assigned	
XV107		Same as XV1	Figure 5-16
XV108		Not Assigned	
XV109		Same as XV1	Figure 5-16
XV110-XV112		Not Assigned	
XV113		Same as XV1	Figure 5-16
XV114		Same as XV1	Figure 5-16
XV115		Same as XV1	Figure 5-16
XV116-XV200		Not Assigned	
XV201		Same as XV1	Figure 5-21
XV202		Same as XV1	Figure 5-21
XV203		Same as XV1	Figure 5-20
XV204		Same as XV1	Figure 5-20
XV205		Same as XV1	Figure 5-20
XV206		Same as XV1	Figure 5-20
XV207		Same as XV1	Figure 5-20
XV208-XV300		Not Assigned	
XV301		Same as XV1	Figure 5-23
XV302		SOCKET, ELECTRON TUBE, 7 pin, miniature stand-off type, mica filled phenolic body, with two integrally molded tube retainer lugs, (91662 #3706-2-4)	Figure 5-23
XV303		SOCKET, ELECTRON TUBE, 9 pin, noval, stand-off type, mica filled phenolic body, (71785 #44P24810)	Figure 6-6
XV304		Same as XV303	Figure 6-6
XV305		SOCKET, ASSEMBLY, WIRED, (28569 #19350-384)	
XV306		Same as XV1	Figure 5-23
XV307		Same as XV302	Figure 5-23

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XV308- XV400		Not Assigned	
XV401		Same as XV302	Figure 5-26
XV402- XV499		Not Assigned	
		MISCELLANEOUS PARTS	
E1		ADAPTER, UG-273 (RE49F389)	
E2		ADAPTER, UG-274A/U (REB49052)	
E3		ADAPTER, UG-255/U (RE49F378)	
E4		ADAPTER, UG-1441/U	
E101		COVER, ELECTRICAL CONNECTOR, CW-123A/U per MIL-C-3608	Gate Output connector cover
E102		Same as E101	Sweep Output connector cover
E104		Same as E101	Trigger Input connector cover
E201		Same as E101	Horizontal Input connector cover
E301		POST, BINDING, red (58474 #BB100-G4) or (28480 #HG-10G)	Calibrator volts output binding post, Figure 3-1
E302		Same as E301	Calibrator millivolts output binding post, Figure 3-1
E303		BINDING POST, black (58474 #BB10035-G3) or (28480 #G-10C)	Calibrator ground binding post, Figure 3-1
E304		INSULATOR, BUSHING, (58474 #BB1038-G4) or (28480 #G-83G)	Insulator for E301
E305		Same as E304	Insulator for E302
E306		SHIELD, CRT, MUMETAL (28569 #19912-392)	
E307		INSULATOR, potentiometer cover, molded	Cap for R309
E308		Same as E307	Cap for R326
J1		CONNECTOR, RECEPTACLE, ELECTRICAL, 16 pin, phenolic body, single mating end, (02660 #26-4200-16S)	Oscilloscope - dual trace preamplifier connector, Figure 5-6
J2- J100		Not Assigned	
J101		CONNECTOR, RECEPTACLE, ELECTRICAL, UG-625B/U per MIL-C-3608	External trigger input connector, Figure 3-1
J102		Same as J101	Gate Output connector, Figure 3-1
J103		Not Assigned	
J104		Same as J101	Sweep Output connector, Figure 3-1
J105		CONNECTOR, MALE, 32 contacts, (02660 #26-4200-32S)	Auxiliary Plug-in connector, Figure 5-9
J106- J200		Not Assigned	
J201		Same as J101	Horizontal Input connector, Figure 3-1
MP1		KNOB, RED (28569 #11505-85)	Trigger Slope Switch Knob
MP2		KNOB, BLACK (28569 #11505-87)	Calibrator Switch Knob
MP3		Same as MP2	Focus Control Knob
MP4		Same as MP2	Intensity Control Knob
MP5		Same as MP2	Scale Light Control Knob

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP6		KNOB, BLACK (28569 #11505-90)	Horizontal Display Switch Knob
MP7		Same as MP6	Sweep Time Switch Knob
MP8		Same as MP6	Trigger Level Control Knob
MP9		KNOB, BLACK (28569 #11505-91)	Horizontal Position Control Knob
MP10		Same as MP6	Trigger Source Switch Knob
MP11		KNOB, RED (28569 #11505-94)	External Vernier Control Knob
MP12		Same as MP11	Vernier Control Knob
MP13		Same as MP11	Sweep Mode Control Knob
Dual Trace Preamplifier MX-2930A/USM-105			
A500		SWITCH ASSEMBLY, MODE, consists of rotary switch S505 with the following circuit components: C1587, C1591, C1592, C1593, C1594, R553, R561, R1563, R1564, S505 (28569 stk no. 19915-581)	Vertical Presentation Switch, Figure 3-1
A501		BOARD, ETCHED CIRCUIT, includes: C503, C504, C516, C517, C518, C522, C523, CR501, CR505, L501, L502, L503, L505, L508, L510, L511, L512, L514, L515, L516, L517, L518, L519, Q501, Q502, Q503, Q504, R501, R502, R503, R505, R507, R509, R512, R513, R514, R515, R516, R517, R518, R519, R521, R522, R523, R524, R525, R527, R528, R529, R531, R532, R533, R534, R535, R536, R537, R538, R539, R542, R544, R545, R547, R548, R549, R550, R551, R552, R571, R572, R573, R574, R575, R576, R580, R581, R582, R583, R584, R585, R586, R587, R588, R589, V501, V502, V503, V504, V505, V506, XV501, XV502, XV503, XV504, XV505, XV506 (28569 stk. no. 2420-563)	Dual channel ampl. circuit board, Figure 5-5
A502		BOARD, ETCHED, CIRCUIT, includes C506, C507, C508, C509, C510, C511, C515, C519, CR502, CR503, CR504, CR506, L513, R526, R554, R556, R557, R558, R559, R560, R562, R563, R564, R565, R566, R567, R568, R569, R570, R579, R591, R592, T501, V507, V508, V509, XV507, XV508, XV509, (28569 stk. no. 2420-562)	Channel switching circuit board, Figure 5-8
A1500		ATTENUATOR ASSEMBLY, REPAIRABLE, CHANNEL 'A' includes C1544, C1545, C1547, C1548, C1549, C1551, C1552, C1553, C1555, C1556, C1557, C1558, C1559, C1560, C1561, C1562, C1563, C1564, C1565, C1566, C1567, C1568, C1569, C1571, C1572, C1573, C1575, C1576, C1577, C1579, C1580, C1581, R1532, R1534, R1536, R1538, R1540, R1543, R1546, R1549, R1553, (28569 stk. no. 2420-560)	Channel 'A' input attenuator board, Figure 5-8
A1501		ATTENUATOR ASSEMBLY, REPAIRABLE, CHANNEL 'B' includes C1504, C1505, C1506, C1508, C1509, C1510, C1512, C1513, C1514, C1515, C1516, C1517, C1518, C1519, C1520, C1521, C1522, C1523, C1524, C1525, C1526, C1528, C1529, C1530, C1532, C1533, C1534, C1536, C1537, C1538, C1540, C1561, R1502, R1504, R1506, R1508, R1510, R1513, R1516, R1519, R1523 (28569 stk. no. 2420-561)	Channel 'B' input attenuator board, Figure 5-8
AT1500		ATTENUATOR ASSEMBLY	Includes A1500 and A1501 and associated circuits

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C500- C502		Not Assigned	
C503		Same as C6	Decoupling Capacitor for +110v supply, Figure 5-29
C504		Same as C6	Decoupling Capacitor for -100v supply, Figure 5-29
C505		Not Assigned	
C506		Same as C6	Coupling Capacitor for V508, Figure 5-30
C507		Same as C6	Coupling Capacitor for V507, Figure 5-30
C508		Same as C6	Coupling Capacitor for V507, Figure 5-30
C509		Same as C15	Frequency Adjusting Capacitor for V508, Figure 5-30
C510		Same as C15	Frequency Adjusting Capacitor for V508, Figure 5-30
C511		Same as C6	Bypass Capacitor for V508 Cathode, Figure 5-30
C512- C514		Not Assigned	
C515		Same as C6	Decoupling Capacitor for +70v supply to V502 and V505, Figure 5-30
C516		Same as C6	Decoupling Capacitor for +70v supply to V502 and V505, Figure 5-29
C517		CAPACITOR, FIXED, PAPER, insulated metal case, .1 uf, 10%, 100 volts, type CP05A1KB104K3 per MIL-C-25C	Decoupling Capacitor for +70v supply to V504, Figure 5-29
C518		Same as C517	Decoupling Capacitor for +70v supply to V501, Figure 5-29
C519		Same as C6	Decoupling Capacitor for +110v supply to V508, Figure 5-30
C520- C521		Not Assigned	
C522		Same as C103	Neutralizer for V503, V506, Figure 5-29
C523		Same as C103	Neutralizer for V503, V506, Figure 5-29
C524- C599		Not Assigned	
C1500		CAPACITOR, FIXED, CERAMIC, 8.2 uuf ± .25 uuf, 500 Volts, tubular type (72982 #301-651C0H829C)	Compensating Capacitor for vertical attenuator Channel B, Figure 5-34
C1501		Same as C202	Input Capacitor for Channel A, located on S501

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1502		Same as C202	Input Capacitor for Channel B, located on S503
C1503		Same as C1500	Compensating Capacitor for vertical attenuator Channel B, Figure 5-34
C1504		CAPACITOR, VARIABLE, 0.7-3 uuf, 350V., (72982 type 535 #SK-1549-01-000)	.05 Atten. Comp. for Channel B, Figure 5-32
C1505		Same as C1504	.05 Cap. Adj. for Channel B, Figure 5-32
C1506		Same as C1500	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1507		Same as C5	Compensating Capacitor for vertical attenuator Channel B, Figure 5-34
C1508		Same as C1504	.1 Atten. Comp. for Channel B, Figure 5-32
C1509		Same as C1504	.1 Cap Adj. for Channel B, Figure 5-32
C1510		CAPACITOR, FIXED, MICA: 22 uuf, 5%, 300 Volts, type CM15C220JN3 per MIL-C-5B	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1511		CAPACITOR, FIXED, CERAMIC, 5.6 uuf ± .25 uuf, 500 Volts, tubular type, (72982 #301-651C0H569C)	Compensating Capacitor for vertical attenuator Channel B, Figure 5-34
C1512		Same as C1504	.2 Atten. Comp. for Channel B, Figure 5-32
C1513		Same as C1504	.2 Cap. Adj. for Channel B, Figure 5-32
C1514		Same as C1511	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1515		CAPACITOR, FIXED, MICA, 39 uuf, 5%, 300 Volts, type CM15C390JN3 per MIL-C-5B	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1516		Same as C1504	.5 Atten. Comp. for Channel B, Figure 5-32
C1517		Same as C1504	.5 Cap. Adj. for Channel B, Figure 5-32
C1518		Same as C5	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1519		Same as C1515	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1520		Same as C1504	1 Atten. Comp. for Channel B, Figure 5-32
C1521		Same as C1504	1 Cap. Adj. for Channel B, Figure 5-32
C1522		Same as C5	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1523		Same as C1	Compensating Capacitor for vertical attenutator Channel B, Figure 5-32
C1524		Same as C1504	2 Cap. Adj. for Channel B, Figure 5-32
C1525		Same as C5	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1526		Same as C1504	2 Atten. Comp. for Channel B, Figure 5-32
C1527		CAPACITOR, FIXED, MICA, 220 uuf, 5%, 300 Volts, type CB11RD221J per MIL-C-10950B	Compensating Capacitor for vertical attenuator Channel B, located opposite C1517
C1528		Same as C1504	5 Cap. Adj. for Channel B, Figure 5-32
C1529		Same as C5	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1530		Same as C1504	5 Atten. Comp. for Channel B, Figure 5-32
C1531		CAPACITOR, FIXED, MICA, 470 uuf, 5%, 300 Volts, type CB11RD471J per MIL-C-10950B	Compensating Capacitor for vertical attenuator Channel B, located opposite C1521
C1532		Same as C1504	10 Cap. Adj. for Channel B, Figure 5-32
C1533		Same as C5	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1534		Same as C1504	10 Atten. Comp. for Channel B, Figure 5-32
C1535		CAPACITOR, FIXED, MICA, 1000 uuf, 300 Volts, type CB11RD102J per MIL-C-10950B, 5%	Compensating Capacitor for vertical attenuator Channel B, located opposite C1528

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1536		Same as C1504	20 Cap. Adj. for Channel B, Figure 5-32
C1537		Same as C5	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1538		Same as C1504	20 Atten. Comp. for Channel B, Figure 5-32
C1539		CAPACITOR, FIXED, MICA, 2000 uuf, 5%, 500 Volts, (00853 #M23-2000-E5-500 V)	Compensating Capacitor for vertical attenuator Channel B, located opposite C1532
C1540		Same as C110	Compensating Capacitor for vertical attenuator for Channel B, Figure 5-32
C1541		Same as C110	Compensating Capacitor for vertical attenuator Channel B, Figure 5-32
C1542		Not Assigned	
C1543		Same as C1500	Compensating Capacitor for vertical attenuator Channel A, Figure 5-33
C1544		Same as C110	Compensating Capacitor for vertical attenuator for Channel A, Figure 5-31
C1545		Same as C110	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1546		Same as C1500	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1547		Same as C1504	.05 Atten. Comp. for Channel A, Figure 5-31
C1548		Same as C1504	.05 Cap. Adj. for Channel A, Figure 5-31
C1549		Same as C1500	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1550		Same as C5	Compensating Capacitor for vertical attenuator Channel A, Figure 5-33
C1551		Same as C1504	.1 Atten. Comp. for Channel A, Figure 5-31
C1552		Same as C1504	.1 Cap. Adj. for Channel A, Figure 5-31

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1553		Same as C1510	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1554		Same as C1511	Compensating Capacitor for vertical attenuator Channel A, Figure 5-33
C1555		Same as C1504	.2 Atten. Comp. for Channel A, Figure 5-31
C1556		Same as C1504	.2 Cap. Adj. for Channel A, Figure 5-31
C1557		Same as C1511	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1558		Same as C1515	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1559		Same as C1504	.5 Atten. Comp. for Channel A, Figure 5-31
C1560		Same as C1504	.5 Cap. Adj. for Channel A, Figure 5-31
C1561		Same as C5	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1562		Same as C1515	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1563		Same as C1504	1 Atten. Comp. for Channel A, Figure 5-31
C1564		Same as C1504	1 Cap. Adj. for Channel A, Figure 5-31
C1565		Same as C5	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1566		Same as C1	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1567		Same as C1504	2 Cap. Adj. for Channel A, Figure 5-31
C1568		Same as C5	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1569		Same as C1504	2 Atten. Comp. for Channel A, Figure 5-31

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1570		Same as C1527	Compensating Capacitor for vertical attenuator Channel A, located opposite C1564
C1571		Same as C1504	5 Cap. Adj. for Channel A, Figure 5-31
C1572		Same as C5	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1573		Same as C1504	5 Atten. Comp. for Channel A, Figure 5-31
C1574		Same as C1531	Compensating Capacitor for vertical attenuator Channel A, located opposite C1567
C1575		Same as C1504	10 Cap. Adj. for Channel A, Figure 5-31
C1576		Same as C5	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1577		Same as C1504	10 Atten. Comp. for Channel A, Figure 5-31
C1578		Same as C1535	Compensating Capacitor for vertical attenuator Channel A, located opposite C1575
C1579		Same as C1504	20 Cap. Adj. for Channel A, Figure 5-31
C1580		Same as C5	Compensating Capacitor for vertical attenuator Channel A, Figure 5-31
C1581		Same as C1504	20 Atten. Comp. for Channel A, Figure 5-31
C1582		Same as C1539	Compensating Capacitor for vertical attenuator Channel A, located opposite C1579
C1583-C1586		Not Assigned	
C1587		Same as C110	Compensating Capacitor for vertical input Channel B, Figure 5-28
C1588		Same as C303	Bypass Capacitor for R1561 vertical input Channel A, located on S502
C1589		Same as C1500	Compensating Capacitor for vertical input Channel A, located at junction of C1590 to ground

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1590		Same as C1504	"A" Cap. Adj, Figure 6-2
C1591		Same as C303	Bypass Capacitor for R1563, Figure 5-28
C1592		CAPACITOR, VARIABLE, 0.7-3 uuf, 350 V., (72982 type 535 #SK1459-000)	"A-B" Cap. Adj, Figure 5-28
C1593		Same as C6	Compensating Capacitor for vertical input, Figure 5-28
C1594		Same as C1592	"B" Cap, Adj, Figure 5-28
C1595		Same as C303	Compensating Capacitor for vertical input Channel B, located at junction of C1594 to ground
C1596-C1599		Not Assigned	
CR500		Not Assigned	
CR501		SEMI-CONDUCTOR DEVICE, DIODE, 1N276 per MIL-E-1/1025	Coupling Diode for Q501, Q502, Figure 5-29
CR502		SEMI-CONDUCTOR DEVICE, DIODE, 1N277 per MIL-E-1/993A	Coupling Diode for V508A, Figure 5-30
CR503		Same as CR502	Coupling Diode for V508B, Figure 5-30
CR504		Same as CR502	Clamp Diode for V507B, Figure 5-30
CR505		Same as CR501	Coupling Diode for Q503, Q504, Figure 5-29
CR506		SEMI-CONDUCTOR DEVICE, DIODE, single anode Zener 1/4 M56Z5 (1N979B per MIL-E-1/117)	Reference Diode for V508 cathode, Figure 5-30
J501	**	Same as J101	Dual Trace Pre-amplifier INPUT connector, Figure 3-1
J502		Same as J101	Dual Trace Pre-amplifier INPUT connector, Figure 3-1
L500		Not Assigned	
L501		COIL, RF, 1.55-2.6 uh at 30 mc, 17 turns #32 AWG formvar on National Coil type NCF1M coil form, National Coil #804 adjustable iron core (95265 type C577)	Peaking Coil for Q501, Figure 5-29
L502		Same as L501	Peaking Coil for Q502, Figure 5-29
L503		COIL, RF, 4.7 uh, 10%, 350 ma dc, 1.8 ohms dc res., phenolic coil form, molded phenolic body, (99800 #2150-16)	Peaking Coil for V503A, Figure 5-29
L504		Not Assigned	
L505		Same as L503	Peaking coil for V503B, Figure 5-29
L506-L507		Not Assigned	
L508		Same as L503	Peaking coil for V506A, Figure 5-29
L509		Not Assigned	
L510		Same as L503	Peaking coil for V506B, Figure 5-29

**Note: For E501 and E502 refer to MISCELLANEOUS PARTS Pages 7-47 and 7-48.

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L511		Same as L501	Peaking Coil for Q503, Figure 5-29
L512		Same as L501	Peaking coil for Q504, Figure 5-29
L513		Same as L31	Filter coil for +110v supply, Figure 5-30
L514		COIL, RF, .68 uh, 20%, 1165 ma dc res., phenolic body, (99800 #1537-08)	Peaking coil for Q501, Figure 5-29
L515		Same as L514	Peaking coil for Q502, Figure 5-29
L516		Same as L1	Peaking coil for V503, V506, Figure 5-29
L517		Same as L1	Peaking coil for V503, V506, Figure 5-29
L518		Same as L514	Peaking coil for Q503, Figure 5-29
L519		Same as L514	Peaking coil for Q504, Figure 5-29
P501		CONNECTOR, RECEPTACLE, ELECTRICAL, 16 contacts, single mating end (02660 #26-4100-16P)	Oscilloscope - dual trace preamplifier connector, Figure 5-6
Q501		Same as Q201	Channel A Differential Amplifier, Figure 5-29
Q502		Same as Q201	Channel A Differential Amplifier, Figure 5-29
Q503		Same as Q201	Channel B Differential Amplifier, Figure 5-29
Q504		Same as Q201	Channel B Differential Amplifier, Figure 5-29
R500		Not Assigned	
R501		Same as R444	Cathode Resistor for V501A, Figure 5-29
R502		Same as R444	Cathode Resistor for V501B, Figure 5-29
R503		RESISTOR, FIXED, COMPOSITION, 56 ohms, 10%, 1/4 Watt, type RC07GF560K per MIL-R-11C	Parasitic Suppressor for V502A, Figure 5-29
R504		RESISTOR, VARIABLE, composition, 5000 ohms, 20%, 2 Watt, type RV4NAYSB502B per MIL-R-94B	Sens itivity Calibrator Adj, for Channel A, Figure 3-1
R505		Same as R503	Parasitic Suppressor for V502B, Figure 5-29
R506		Not Assigned	
R507		Same as R142	Cathode Resistor for V502A, Figure 5-29
R508		RESISTOR, VARIABLE, composition, 2500 ohms, 20%, 2 Watt, type RV4NAYSD252B per MIL-R-94B	Vernier Balance Adj, for Channel A, Figure 3-1
R509		Same as R142	Cathode Resistor for V502B, Figure 5-29
R510		RESISTOR, VARIABLE, dual tandem, 250 ohms, 10%, 1 Watt each section, includes S508 dpst switch, (71450 type RWF2-90)	Vernier Control for Channel A, Figure 3-1
R511		Not Assigned	
R512		RESISTOR, FIXED, COMPOSITION, 30,000 ohms, 5%, 1/2 Watt, type RC20GF303J per MIL-R-11C	Emitter Resistor for Q501, Figure 5-29
R513		Same as R512	Emitter Resistor for Q502, Figure 5-29
R514		Same as R180	Bias Resistor for Q501, Q502, Figure 5-29

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R515		Same as R272	Bias Voltage Divider Resistor for Q501, Q502, Figure 5-29
R516		RESISTOR, FIXED, FILM, 1300 ohms, 1%, 1/8 Watt, type RN60B1301F per MIL-R-10509C	Collector Load Resistor for Q501, Figure 5-29
R517		Same as R516	Collector Load Resistor for Q502, Figure 5-29
R518		RESISTOR, FIXED, FILM, 15,000 ohms, 1%, 1/4 Watt, type RN65B1502F per MIL-R-10509C	Grid Return Resistor for V503A, Figure 5-29
R519		Same as R142	Bias Voltage Divider Resistor for V503A, Figure 5-29
R520		Part of Switch S506, not separately replaceable	VERTICAL POSITION control for Channel A, Figure 3-1
R521		Same as R142	Bias Voltage Divider Resistor for V503B, Figure 5-29
R522		Same as R518	Grid Return Resistor for V503B, Figure 5-29
R523		RESISTOR, FIXED, FILM, 5,000 ohms, 1%, 1 Watt, (19701 type DC1)	Cathode Resistor for V503A, V506A, Figure 5-29
R524		Same as R523	Cathode Resistor for V503B, V506B, Figure 5-29
R525		Same as R30	Filter Resistor +110v supply, Figure 5-29
R526		Same as R180	Coupling Resistor for V507B, Figure 5-30
R527		Same as R503	Parasitic Suppressor for V501A, Figure 5-29
R528		Same as R503	Parasitic Suppressor for V501B, Figure 5-29
R529		Same as R142	Bias Voltage Divider Resistor for V506A, Figure 5-29
R530		Part of Switch S507, not separately replaceable	VERTICAL POSITION control for Channel B, Figure 3-1
R531		Same as R142	Bias Voltage Divider Resistor for V506B, Figure 5-29
R532		Same as R518	Grid Return Resistor for V506A, Figure 5-29
R533		Same as R518	Grid Return Resistor for V506B, Figure 5-29
R534		Same as R516	Collector Load Resistor for Q503, Figure 5-29
R535		Same as R516	Collector Load Resistor for Q504, Figure 5-29
R536		Same as R272	Bias Voltage Divider Resistor for Q503, Q504, Figure 5-29
R537		Same as R180	Bias Resistor for Q503, Q504, Figure 5-29
R538		Same as R512	Emitter Resistor for Q503, Figure 5-29

TABLE 7- 1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R539		Same as R512	Emitter Resistor for Q504, Figure 5-29
R540		Same as R510, includes S509	Vernier Control for Channel B, Figure 3-1
R541		Not Assigned	
R542		Same as R142	Cathode Resistor for V505A, Figure 5-29
R543		Same as R508	Vernier Balance Adj. for Channel B, Figure 5-29
R544		Same as R142	Cathode Resistor for V505B, Figure 5-29
R545		Same as R503	Parasitic Suppressor for V505A, Figure 5-29
R546		Same as R504	Sensitivity Balance Adj, for Channel B, Figure 3-1
R547		Same as R503	Parasitic Suppressor for V505B, Figure 5-29
R548		Same as R444	Cathode Resistor for V504A, Figure 5-29
R549		Same as R444	Cathode Resistor for V504B, Figure 5-29
R550		Same as R503	Parasitic Suppressor for V504A, Figure 5-29
R551		Same as R503	Parasitic Suppressor for V504B, Figure 5-29
R552		RESISTOR, FIXED, COMPOSITION, 2000 ohms, 5%, 2 Watt, type RC42GF202J per MIL-R-11C	Cathode Resistor for V503, V506, Figure 5-29
R553		RESISTOR, FIXED, COMPOSITION, 1800 ohms, 10%, 1/2 Watt, type RC20GF182K per MIL-R-11C	ALTERNATE Grid Return Resistor for V507A, Figure 5-28
R554		Same as R503	Parasitic Suppressor for V507A, Figure 5-30
R555		Same as R324	Grid Return Resistor for V507A, Figure 5-30
R556		Same as R109	Plate Load Resistor for V507A, Figure 5-30
R557		Same as R144	Load Resistor for V509, Figure 5-30
R558		Same as R503	Parasitic Suppressor for V507B, Figure 5-30
R559		Same as R1	Grid Return Resistor for V507B, Figure 5-30
R560		Same as R254	Cathode Resistor for V507B, Figure 5-30
R561		RESISTOR, FIXED, COMPOSITION, 1500 ohms, 10%, 1/2 Watt, type RC20GF152K per MIL-R-11C	Coupling Resistor for blanking to HV supply, Figure 5-28
R562		RESISTOR, FIXED, FILM, 10K ohms, 5%, 3 Watt, (14674 #LPI-3-10K-5%)	Plate Load Resistor for V508B, Figure 5-30
R563		Same as R141	Coupling Resistor for V508, Figure 5-30
R564		Same as R503	Parasitic Suppressor for V508B, Figure 5-30
R565		Same as R141	Grid Return Resistor for V508B, Figure 5-30

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R566		Same as R141	Coupling Resistor for V508A, Figure 5-30
R567		Same as R503	Parasitic Suppressor for V508A, Figure 5-30
R568		Same as R141	Grid Return Resistor for V508A, Figure 5-30
R569		Same as R562	Plate Load Resistor for V508A, Figure 5-30
R570		RESISTOR, FIXED, COMPOSITION, 3900 ohms, 10%, 2 Watt, type RC42GF392K per MIL-R-11C	Cathode Resistor for V508, Figure 5-30
R571		RESISTOR, FIXED, COMPOSITION, 2200 ohms, 10%, 1/4 Watt, type RC07GF222K per MIL-R-11C	Coupling Resistor for V503A, Figure 5-29
R572		Same as R571	Coupling Resistor for V503B, Figure 5-29
R573		Same as R571	Coupling Resistor for V506A, Figure 5-29
R574		Same as R571	Coupling Resistor for V506B, Figure 5-29
R575		RESISTOR, FIXED, FILM, 470 ohms, 10%, 4 Watt, (14674 #LPI-4-470-10%)	Dropping Resistor for +70v supply, Figure 5-29
R576		Same as R30	Filter Resistor, Figure 5-29
R577-R578		Not Assigned	
R579		RESISTOR, FIXED, COMPOSITION, 1000 ohms, 10%, 1/2 Watt, type RC20GF102K per MIL-R-11C	Dropping Resistor for +110v supply, Figure 5-30
R580		RESISTOR, FIXED, COMPOSITION, 3900 ohms, 10%, 1/2 Watt, type RC20GF392K per MIL-R-11C	Dropping Resistor for +70v supply B, Figure 5-29
R581		Same as R580	Dropping Resistor for +70 volt supply A, Figure 5-29
R582		RESISTOR, FIXED, COMPOSITION, 68 ohms, 10%, 1/4 Watt, type RC07GF680K per MIL-R-11C	Collector Load for Q501, Figure 5-29
R583		Same as R582	Collector Load for Q502, Figure 5-29
R584		Same as R523	Plate Resistor For V503A, V506A, Figure 5-29
R585		Same as R523	Plate Resistor for V503A, V506B, Figure 5-29
R586		RESISTOR, FIXED, COMPOSITION, 470 ohms, 10%, 1/2 Watt, type RC20GF471K per MIL-R-11C	Coupling Resistor for V503A, V506A, Figure 5-29
R587		Same as R586	Coupling Resistor for V503B, V506B, Figure 5-29
R588		Same as R582	Collector Load for Q503, Figure 5-29
R589		Same as R582	Collector Load for Q504, Figure 5-29
R590		Same as R58	Dropping Resistor for +370v supply D, located on rear section of S505
R591		Same as R553	Coupling Resistor for V508A, Figure 5-30

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R592		Same as R553	Coupling Resistor for V508B, Figure 5-30
R593		Same as R586	Shunt Resistor R501, Figure 5-30
R594-R599		Not Assigned	
R1500		Same as R503	Attenuator Resistor Channel B, Figure 5-34
R1501		RESISTOR, FIXED, FILM, 600K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-34
R1502		RESISTOR, FIXED, FILM, 667K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-32
R1503		RESISTOR, FIXED, FILM, 800K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-34
R1504		RESISTOR, FIXED, FILM, 250K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-32
R1505		Same as R203	Attenuator Resistor Channel B, Figure 5-34
R1506		Same as R204	Attenuator Resistor Channel B, Figure 5-32
R1507		RESISTOR, FIXED, FILM, 960K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-34
R1508		RESISTOR, FIXED, FILM, 41.7K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2	Attenuator Resistor Channel B, Figure 5-32
R1509		RESISTOR, FIXED, FILM, 980K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-34
R1510		RESISTOR, FIXED, FILM, 20.4K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-32
R1511		RESISTOR, FIXED, FILM, 990K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-34
R1512		Same as R30	Attenuator Resistor Channel B, Figure 5-34
R1513		RESISTOR, FIXED, FILM, 10.1K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-32
R1514		RESISTOR, FIXED, FILM, 996K ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C, (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-34
R1515		Same as R30	Attenuator Resistor Channel B, Figure 5-34
R1516		RESISTOR, FIXED, FILM, 4020 ohms, 1%, 1/2 Watt, type RN70B4021F per MIL-R-10509C	Attenuator Resistor Channel B, Figure 5-32
R1517		Same as R205	Attenuator Resistor Channel B, Figure 5-34

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1518		Same as R30	Attenuator Resistor Channel B, Figure 5-34
R1519		RESISTOR, FIXED, FILM, 1990 ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-32
R1520		Same as R205	Attenuator Resistor Channel B, Figure 5-34
R1521		Same as R16	Attenuator Resistor Channel B, Figure 5-34
R1522		RESISTOR, FIXED, COMPOSITION, 4.7 ohms, 5%, 1/2 Watt, (01121 #EB47G5)	Attenuator Resistor Channel B, Figure 5-34
R1523		RESISTOR, FIXED, FILM, 995 ohms, 1%, 1/2 Watt, RN70 size per MIL-R-10509C (19701 type CF1/2)	Attenuator Resistor Channel B, Figure 5-32
R1524		Same as R205	Attenuator Resistor Channel B, located at junction of C1594 to ground
R1525- R1529		Not Assigned	
R1530		Same as R503	Channel A Input Resistor, Figure 5-33
R1531		Same as R1501	Attenuator Resistor Channel A, Figure 5-33
R1532		Same as R1502	Attenuator Resistor Channel A, Figure 5-31
R1533		Same as R1503	Attenuator Resistor Channel A, Figure 5-33
R1534		Same as R1504	Attenuator Resistor Channel A, Figure 5-31
R1534		Same as R1504	Attenuator Resistor Channel A, Figure 5-31
R1535		Same as R203	Attenuator Resistor Channel A, Figure 5-33
R1536		Same as R204	Attenuator Resistor Channel A, Figure 5-31
R1537		Same as R1507	Attenuator Resistor Channel A, Figure 5-33
R1538		Same as R1508	Attenuator Resistor Channel A, Figure 5-31
R1539		Same as R1509	Attenuator Resistor Channel A, Figure 5-33
R1540		Same as R1510	Attenuator Resistor Channel A, Figure 5-31

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1541		Same as R1511	Attenuator Resistor Channel A, Figure 5-33
R1542		Same as R30	Attenuator Resistor Channel A, Figure 5-33
R1543		Same as R1513	Attenuator Resistor Channel A, Figure 5-31
R1544		Same as R1514	Attenuator Resistor Channel A, Figure 5-33
R1545		Same as R30	Attenuator Resistor Channel A, Figure 5-33
R1546		Same as R1516	Attenuator Resistor Channel A, Figure 5-31
R1547		Same as R205	Attenuator Resistor Channel A, Figure 5-33
R1548		Same as R30	Attenuator Resistor Channel A, Figure 5-33
R1549		Same as R1519	Attenuator Resistor Channel A, Figure 5-31
R1550		Same as R205	Attenuator Resistor Channel A, Figure 5-33
R1551		Same as R16	Attenuator Resistor Channel A, Figure 5-33
R1552		Same as R1522	Attenuator Resistor Channel A, Figure 5-33
R1553		Same as R1523	Attenuator Resistor Channel A, Figure 5-31
R1554- R1559		Not Assigned	
R1560		Same as R205	Attenuator Resistor for Vert. Amp, located at junction C1590 to ground
R1561		Same as R1	Attenuator Resistor for Vert. Amp, located on S502
R1562		Not Assigned	
R1563		Same as R1	Attenuator Resistor for Vert. Amp, Figure 5-28
R1564		Same as R328	Attenuator Resistor for Vert. Amp, Figure 5-28
R1565- R1567		Not Assigned	
R1568		Same as R328	Attenuator Resistor for Vert. Amp, located on S504

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
S500		Not Assigned	
S501		SWITCH, ROTARY, 1 section, 1 pole, 2 positions (28569 #19912-248)	AC-DC Switch (Channel A), Figure 3-1
S502		SWITCH, ROTARY, 10 positions, 2 section (28569 #19912-431)	Sensitivity Switch for Channel A, Figure 5-33
S503		Same as S501	AC-DC Switch (Channel B), Figure 3-1
S504		Same as S502	Sensitivity Switch for Channel B, Figure 5-34
S505		SWITCH, ROTARY, 3 section, 5 position (28569 #19912-430)	Vertical Presentation Switch, Figure 5-28
S506		SWITCH, ROTARY, 1 section, 2 position (28569 #19912-429) (includes R520)	Polarity Switch for Channel A, Figure 3-1
S507		Same as S506 includes R530	Polarity Switch for Channel B, Figure 3-1
S508		Part of R510 not separately replaced	
S509		Part of R540 not separately replaced	
T500		Not Assigned	
T501		TRANSFORMER, pulse (28569 #20800-262)	Coupling Transformer for V508, Figure 5-30
V500		Not Assigned	
V501		ELECTRON TUBE, 7308	Channel A Input Cathode Follower
V502		Same as V501	Channel A Transistor Driver
V503		Same as V1	Channel A Output Cathode Follower
V504		Same as V501	Channel B Input Cathode Follower
V505		Same as V501	Channel B Transistor Driver
V506		Same as V1	Channel B Output Cathode Follower
V507		Same as V1	Amplifier and Cathode Follower
V508		Same as V1	Switching Multivibrator
V509		Same as DS402	DC reference Diode for V507B Grid, Figure 5-30
XV500		Not Assigned	
XV501		Same as XV1	Figure 5-29
XV502		Same as XV1	Figure 5-29
XV503		Same as XV2	Figure 5-29
XV504		Same as XV1	Figure 5-29
XV505		Same as XV1	Figure 5-29
XV506		Same as XV2	Figure 5-29
XV507		SOCKET, ELECTRON TUBE, 9 pin noval stand-off type, mica filled phenolic body, (71785 #44P24233)	Figure 5-30
XV508		Same as XV1	Figure 5-30
		MISCELLANEOUS PARTS	
E501		Same as E101	Cover for Channel A Input connector

TABLE 7-1. MAINTENANCE PARTS LIST (CONTINUED)

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E502		Same as E101	Cover for Channel B Input connector
MP500		Same as MP1	Channel A Polarity switch knob
MP501		Same as MP1	Channel B Polarity switch knob
MP502		Same as MP2	Mode Selector switch knob
MP503		Same as MP2	Channel A AC-DC switch knob
MP504		Same as MP2	Channel B AC-DC switch knob
MP505		Same as MP6	Channel A Sensitivity switch knob
MP506		Same as MP6	Channel B Sensitivity switch knob
MP507		KNOB, BLACK (28569 #11505-92)	Channel A Vertical Position control knob
MP508		Same as MP507	Channel B Vertical Position control knob
MP509		Same as MP11	Channel A Vernier control knob
MP510		Same as MP11	Channel B Vernier control knob
Auxiliary Plug-in MX-3078/USM-105A			
C2001		CAPACITOR, FIXED, CERAMIC, .01 uf, 20%, 500 Volts, disc type, type CK63AW103M per MIL-C-11015B	Arming Input Capacitor, Figure 5-7
CR2001		SEMI-CONDUCTOR DEVICE, DIODE, 1N277 per MIL-E-1/993A	Coupling diode for Arming Input, Figure 5-7
DS2001		LAMP, GLOW, MS25252-NE2D per MIL-L-15098B	Sweep Armed Indicator, Figure 3-1
J2001		CONNECTOR, RECEPTACLE, ELECTRICAL, UG-625B/U per MIL-C-3608	Intensity Modulation Input, Figure 3-1
J2002		Same as J2001	Arming Input, Figure 3-1
P2001		CONNECTOR, male, 32 contacts (02660 #26-4100-32P)	Interconnecting plug, Figure 5-9
R2001		RESISTOR, FIXED, COMPOSITION, 1 megohm, 10%, 1/2 Watt, type RC20GF105K per MIL-R-11C	Bypass Resistor for CR2001, Figure 5-7
S2001		SWITCH, TOGGLE, DPDT, MIL type MS25100-23 per MIL-S-3950A	Intensity Modulation Switch, Figure 3-1
S2002		Same as S2001	Sweep Occurence Switch, Figure 3-1
XDS2001		SOCKET, LAMPHOLDER, front mtg., 2 terminals for T-2 neon glow lamp, (96312 #137-7336-937)	
MISCELLANEOUS PARTS			
E2001		Same as E101	Input connector cover
E2002		Same as E101	Arming Input connector cover

TABLE 7-2. LIST OF MANUFACTURERS

CODE NO.	MANUFACTURER
00853	Sangamo Electric Co., 1207 N. Eleventh St., Springfield, Ill.
01121	Allen Bradley Co., 118 W. Greenfield Ave., Milwaukee 4, Wisc.
01295	Texas Instruments Inc., 13500 N. Central Expwy., Box 5474, Dallas, Texas
02114	Ferroxcube Corp. of America, 125 E. Bridge St., Saugerties, N.Y.
02642	Tech-Ohm Electronics, Inc., 36-11 33rd St., Long Island City, N.Y.
02660	Amphenol-Borg Electronics, 1830 South 54th Ave., Chicago 50, Ill.
12697	Clarostat Mfg. Co., Inc., Washington Street, Brooklyn, N.Y.
14674	Corning Glass Works, Electrical Products Div., Corning, N.Y.
19701	Electra Mfg. Co., 4051 Broadway, Kansas City, Mo.
28480	Hewlett-Packard Co., 1058 Page Mill Road, Palo Alto, Calif.
28569	Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio
56289	Sprague Electric Co., 481 Marshall St., North Adams, Mass.
58474	Superior Electric Co., 83 Laurel St., Bristol, Conn.
71400	Bussman Mfg. Co., University at Jefferson St., St. Louis, Mo.
71450	Chicago Telephone Supply, Elkhart, Ind.
71590	Centralab Div. of Globe Union Inc., 900AE Keefe Ave., Milwaukee, Wisc.
71785	Cinch Mfg. Corp., 1026 So. Homan Ave., Chicago 24, Ill.
72982	Erie Resistor Corp., 644 West 12th St., Erie, Pa.
73138	Helipot Corp., 2500 Harbor Blvd., South Pasadena, Calif.
76433	Micamold Electronics Mfg. Corp., 65 Governeur St., Newark, N.J.
76854	Oak Mfg. Co., 1260 Clybourn Ave., Chicago, Ill.
77764	Resistance Products Co., 914 South 13th St., Harrisburg, Pa.
80211	Motorola Semiconductor Products Inc., 5005 E. McDowell Rd., Phoenix, Ariz.
81716	Oak Mfg. Co., Crystal Lake, Ill.
82647	Klixon Co., Div. of Spencer Thermostat Corp., Attleboro, Mass.
91662	Elco Corp., "M" St. below Erie Ave., Philadelphia, Pa.
93519	General Electric Supply Corp., Lamp Works (Nela Park), Cleveland, Ohio
95265	National Coil Co., Box 1237, Sheridan, Wyo.
96312	Dialight, 60 Stewart Ave., Brooklyn, N.Y.
97315	Ballastran, Div. Telex, 1701 N. Calhoun St., Ft. Wayne, Ind.
99800	Delavan Electronics Corp., 77 Olean Road, East Aurora, N.Y.
98734	Palo Alto Engineering Co. Inc., Palo Alto, Calif.

SECTION 7A

SUPPLEMENTARY PARTS LIST

NOTE

"This parts list has been corrected by means of the following supplementary table. For any given item, always refer first to the appropriate supplementary table, since it completely supersedes any corresponding listing in the basic table. If no information is shown for a given item, refer to the basic table for the required information."

TABLE 7-1A SUPPLEMENTARY PARTS LIST

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C105		CAPACITOR, FIXED, MICA, 240 uf, 5% 500v, type CM15D241JN3 per MIL-C-5B	Bypass capacitor for V101 cathode, Figure 5-16
C107		CAPACITOR, FIXED, MICA, 33 uuf, 5%, 500V, type CM15C330JN3 per MIL-C-5B	Coupling capacitor for V104A, Figure 5-16
C108		CAPACITOR, FIXED, MICA, 75 uuf, 5%, 500V, type CM15C750JN3 per MIL-C-5B	Clamp capacitor for V103 cathode, Figure 5-16
C109		CAPACITOR, FIXED, MICA, 47 uuf, 5%, 500V, type CM15C470JN3 per MIL-C-5B	Coupling capacitor for V104B, Figure 5-16
C114		CAPACITOR, FIXED, MICA, 100 uuf, 5%, 500V, type CM15C101JN3 per MIL-C-5B	Coupling capacitor for V105A, Figure 5-16
C119		CAPACITOR, FIXED, MICA, 220 uuf, 5%, 500V, type CM15D221JN3 per MIL-C-5B	Decoupling capacitor for V105B grid, Figure 5-16
C124		CAPACITOR, FIXED, MICA, 68 uuf, 5%, 500V, (76433 #MCM15D680J)	Bypass capacitor for V109 plate, Figure 5-16
C132		CAPACITOR, FIXED, MICA, 390 uuf, 5%, 500V type CM15D391JN3 per MIL-C-5B	Bypass capacitor for arming input, Figure 5-16
C134		CAPACITOR, FIXED, MICA, 10 uuf, 5%, 500V type CM15B100KN3	Coupling capacitor for V114 grid, Figure 5-16
C302		CAPACITOR, FIXED, PAPER, molded plastic case, .0015 uf, 10%, 6000v, (09023 # PKM-60D15)	Bypass capacitor for V301A, Figure 5-24
C304		CAPACITOR, FIXED, MICA, 470 uuf, 5%, 500v type CM15D471JN3 per MIL-C-5B	Coupling capacitor for V302 grid, Figure 5-23
C306		CAPACITOR, FIXED, PAPER, molded plastic case, .0047 uf, 20%, 6000v, (09023 # PKM-60D47)	Filter capacitor for V303, Figure 6-6
C312		CAPACITOR, FIXED, MICA, 22 uuf, 5%, 500v type CM15C220JN3 per MIL-C-5B	Coupling capacitor for blanking to V305, Figure 5-24
C316		CAPACITOR, FIXED, MICA, 27 uuf, 5%, 500v type CM15C270JN3 per MIL-C-5B	Coupling capacitor for V306B, Figure 5-23
C403		CAPACITOR, FIXED, ELECTROLYTIC, 45 uf, 450v, -40°c to + 85°c, type CE41C450R per MIL-C-62A	Bypass capacitor for CR401, CR402, CR403, CR404, Figure 5-25
C1009		CAPACITOR, FIXED, MICA, 1000 uuf, 2%, 500v, type CM20D102GN3 per MIL-C-5B	Timing capacitor for sweep time on S1001, Figure 5-27

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1011		CAPACITOR, FIXED, MICA, 82uuf, 5%, 500v type CM15C820JN3 per MIL-C-5B	Timing capacitor for sweep on S1001, Figure 5-27
C1013		CAPACITOR, FIXED, MICA, 68uuf, 5%, 500v type CM15C680JN3 per MIL-C-5B	Timing capacitor for sweep on S1001, Figure 5-27
C1015		Same as C312	Timing capacitor for sweep on S1001, Figure 5-27
DS402		LAMP, GLOW, (93519 type NE-2), T-2 clear bulb	Over Heat indicator, Figure 5-8
R10		RESISTOR, VARIABLE, composition, 100 ohms 10%, 2 watt, type RV4LAYSA101A per MIL-R-94B	Gain Adjust resistor, V2, Figure 6-2
R65		Same as R64	Cathode resistor for V5B, Figure 5-14
R178		RESISTOR, VARIABLE, composition, 25,000 ohms, 10%, 2 Watt, type RV4LAYSA253A per MIL-R-94B	Sweep Length Adj., Figure 6-3
R211		RESISTOR, VARIABLE, composition, 1000 ohms, 10%, 2 Watt, type RV4LAYSA102A per MIL-R-94B	Vernier Balance, Figure 6-3
R224		Same as R108	Parasitic Suppressor for V202B, Figure 5-21
R306		RESISTOR, VARIABLE, composition, 1.5 megohms, 10%, 2 Watt, type RV4LAYSA155A per MIL-R-94B	High Voltage Adj., Figure 6-2
R312		RESISTOR, VARIABLE, composition 100K ohms 10%, 2 Watt, type RV4LAYSA104A per MIL-R-94B	Astigmatism Control Figure 6-2
R425		RESISTOR, FIXED, COMPOSITION, 330 ohms, 10%, 1/2 Watt, type RC20GF331K per MIL-R-11C	Coupling Resistor for Q408, Figure 5-26
R443		RESISTOR, FIXED, COMPOSITION, 150 ohms, 10%, 1/2 Watt, type RC20GF151K per MIL-R-11C	Coupling Resistor for Q412, Figure 5-26
R462		Same as R443	Bias Voltage Divider Resistor for Q414, Figure 5-26
S101		SWITCH, ROTARY, 1 section, 4 position, (28569 #19912-513)	Trigger Source (A103) Figure 3-1
S102		SWITCH, ROTARY, 1 section, 2 position, (28569 #19912-514)	Trigger Slope (A100) Figure 3-1
S201		SWITCH, TOGGLE, SPST, type MS35058-22 per MIL-S-3950A	AC-DC, Figure 3-1
S202		SWITCH, ROTARY, 5 section, 16 position, (28569 #19912-527)	Horizontal Display, Figure 3-1, 5-18
S401		SWITCH, TOGGLE, bat handle, DPST, 20A at 115 VAC, 9A at 220 VAC, type MS35059-22 per MIL-S-3950A	Power Switch, Figure 3-1
S1001		SWITCH, ROTARY, 4 section, 24 position, 9 pole (28569 #19912-526)	Sweep Time/CM Switch, Figure 3-2

REF. DESIG.	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
T301		TRANSFORMER, HIGH VOLTAGE, (28569 # 20800-296) (existing stk of 28569 # 20800-261 or 28480 #9110-0128-9 may be used)	High Voltage Power Supply, Figure 6-6
V102		LAMP, GLOW, type NE-76	Voltage dropping element for V101, Figure 5-16

MISCELLANEOUS PARTS

E301	-1-	POST, BINDING, red (58474#BB100-G4) or (28480 #HG-10G)	Calibrator Volts output binding post, Figure 3-1
E302	-1-	Same as E301	Calibrator Millivolts output binding post, Figure 3-1
E303	-1-	BINDING POST, black (58474#BB10035-G3) or (28480 #G-10C)	Calibrator ground binding post, Figure 3-1
E304	-1-	INSULATOR, BUSHING, (58474 #BB1038-G4) or (28480 #G-83G)	Insulator for E301
E305	-1-	Same as E304	Insulator for E302
E309	-2-	Same as E101	Calibrator Volts connector cover
E310	-2-	Same as E101	Calibrator Millivolts connector cover
J301	-2-	CONNECTOR, UG-657/U, per MIL-C-3608A	Calibrator Volts output connector, Figure 3-1
J302	-2-	Same as J301	Calibrator Millivolts output connector, Figure 3-1
MP-14		BEZEL, CRT (28569 #2330-31)	CRT Bezel, Figure 3-1

DUAL TRACE PREAMPLIFIER MX-2930A/USM-105A

L503		COIL, RF, 3.3 uh, 10%, 200 ma dc (99800 #1537-24)	Peaking Coil for V503A, Figure 5-29
R508		RESISTOR, VARIABLE, composition, 2500 ohms, 10%, 2 Watt, type RV4NAYSD252A per MIL-R-94B	Vernier Balance Adj. for Channel A, Figure 3-1
R571		Same as R561	Coupling Resistor for V503A, Figure 5-29
R572		Same as R561	Coupling Resistor for V503B, Figure 5-29
R573		Same as R561	Coupling Resistor for V506A, Figure 5-29
R574		Same as R561	Coupling Resistor for V506B, Figure 5-29
S502		SWITCH, ROTARY, 10 position, 2 section (28569 #19912-523)	Sensitivity Switch for Channel A, Figure 5-33
S506		SWITCH, ROTARY, 1 section, 2 position (28569 #19912-522) (includes R520)	Polarity Switch for Channel A, Figure 3-1

NOTE 1. This part used in equipments bearing serial number prefix letters "A" through "C", only.

NOTE 2. This part used in equipments bearing serial number prefix letter "D", only.